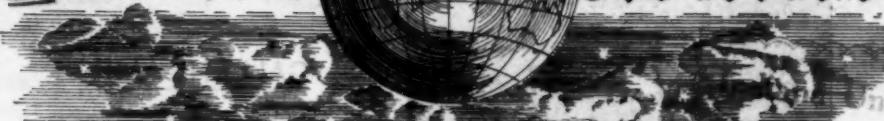


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UTILIZATION OF SOLAR ENERGY

THE main sources from which energy is at present drawn are coal and oil, and it has been estimated that, at the present rate at which these resources are being exhausted, they are not likely to last much more than a few thousand years. A great deal of attention has therefore been paid to the possibility of obtaining power from such perennial sources as running water, the tides and solar energy. It is known that the earth receives a large amount of thermal energy in the form of solar radiation and although there has been much speculation as to the possibility of extracting useful work from this, the problem has not been critically examined in the past. A Committee was recently appointed by the Department of Scientific and Industrial Research of the United Kingdom to investigate this question and their report has recently been published.* According to this report, it seems unlikely that solar energy can be an important source of heat or power in

the near future, though some applications may be possible in specially favourable circumstances.

Although the final conclusion of the Committee thus appears to be not encouraging, the report contains a large amount of valuable information, and it may be worthwhile mentioning some of those here.

Available Energy.—The amount of heat arriving from the sun at the outside of the earth's atmosphere varies only slightly, and is on the average 1.35 kw/m^2 . The amount of energy reaching the ground near sea-level depends on the sun's altitude, the cloudiness and the state of the atmosphere. The maximum of direct radiation on a surface normal to the sun's rays on very clear days reaches 83 per cent. of the incident energy (1.12 kw/m^2) at Ouargla in Algeria. At Kew it is 70 per cent.; other stations give values between these. However, these maxima are rarely attained, and are only useful in estimating the maximum capacity of the plant necessary to make full use of the available energy. The use that can be made of this energy will now be considered.

* Report of the National Physical Laboratory Committee sponsored by the D.S.I.R., Great Britain.

Heating.—Solar water heaters have been on the market in the United States for many years but are used only on a limited scale. The reason is probably that the cost of water heating by other means is not high enough to make the capital expenditure on a solar heater and large storage tank in addition to the normal gas or oil heater seem worthwhile. It is possible that in England where fuel for private consumption is rationed, such heaters could be sold, but even here the competition from unrationed gas and electricity would probably be too severe. It seems unlikely that a campaign to encourage the sale of such heaters would result in a large enough saving of fuel to justify the capital cost. There is no prospect of substantial improvement of existing equipment by research and development.

In the tropics, hot water can be obtained for shower baths, etc., by very simple arrangements. The factor limiting the wide use of such installations is probably the absence in many places of piped water-supply and the lack of demand for hot water.

Cooking.—No one is likely to cook by solar energy if he can get gas, electricity, fuel oil, coal or wood. In some regions, however, none of these are freely available and it is possible that solar energy might find an application there. Cooking in itself does not consume much energy once the food has been brought up to the appropriate temperature. It might well be feasible to construct a solar stove which could satisfy part of the needs of the inhabitants of India, whose main meal is cooked at mid-day and generally consists of boiled rice or some kind of lentils. By designing a stove with suitable insulation to prevent excessive heat losses, it should be possible to reach and maintain temperatures of boiling water with 100 watts; this heat could be collected by a mirror of about 0.3 square metre.

A stove using a mirror and a pressure cooker has been built by the Indian National Physical Laboratory. There is no doubt that it is technically possible to cook food in this way, but it is not certain that the machine can be built at a price which an Indian villager can pay.

Refrigeration.—It seems impracticable to use solar energy directly as the sole source of power for a domestic refrigerator for preserving food, since its operation must be continuous. If another source of power is available the amount required is so small that it would not be worth using solar energy to save part of it. For areas where electric power is not available, refrigerators running on paraffin can be employed.

The use of solar energy for air-conditioning is more attractive, as it is not essential that the system runs continuously. There are well known refrigeration cycles in which heat is pumped out at the cold end and absorbed into the machine at the hot end so it would not be necessary to convert the heat into mechanical energy. It is difficult to estimate the amount of heat required without detailed consideration of design.

Power.—Owing to the intermittency of the supply, the direct use of solar energy for driving engines need not be considered for large power plants. There is, however, a number of purposes for which intermittent power as low as 1 kw would be useful. In particular, the economy of the Indian village might be profoundly affected by the availability of such prime movers for water pumping. Their use for driving the small looms employed in cottage industries has been suggested, but the intermittency of the supply makes it doubtful if they would be acceptable for this purpose. We are thus regrettably forced to the conclusion that orthodox heat engines driven directly by solar power are not an immediate practicable proposition.

Production of Fuel.—The use of solar energy to produce fuel which is subsequently used in an engine is attractive, as it avoids the consequences of the intermittency of sunlight and allows the energy to be used in applications requiring the continuous production of power. The efficiency of the utilization of sunlight by growing plants is remarkable. *Eucalyptus globulus* in India gives 2.4 kilograms of wood per year per square metre (9.4 tons/acre year). The wood has a calorific value of 2.1×10^4 joules/gm. (5,000 cal./gm.). The rate of storage of energy in the wood of an Indian eucalyptus forest is therefore 1.6 w/m^2 or 0.8 per cent. of the energy reaching the ground.

An estimate can be made of the possibilities of the wood fired steam engine for irrigation. If it is assumed that the land to be irrigated requires during the year the equivalent of 0.5 m of water to be raised from a depth of 10 m, it can be shown that the amount of land required for growing fuel for the engine is about 1/50 of the area to be irrigated. The value assumed for yield is what would be obtained under good conditions and is substantially greater than would be expected from peasant holdings. Even if a factor of 5 is allowed on account of optimistic assumptions, the project still seems practicable.

Distillation of Water.—There is scope for the solar distillation of water for drinking purposes

in certain tropical areas. On the assumption that an average of 0.15 kw/m² of radiant energy is available, the evaporation by direct distillation at 100° C. would be approximately 5 kilograms per square metre of heat surface per day. Distillation at pressures below atmospheric would not reduce the heat required per kilogram of water, but the efficiency of heat collection would be greater because of the lower temperature. Considerable improvements have been made recently by introducing black dyes into the solution to increase the proportion of the heat absorbed.

There is great scope for a combination of solar heater and thermal pump. This system would enable almost complete recovery of the latent heat of condensation and would greatly increase the output for a given size of plant.

Conclusions.—It appears therefore that, there is, at present, no way in which the use of solar

energy can make a large contribution to our sources of power. However, energy for domestic hot water heating can in favourable circumstances be obtained and there is scope in certain tropical areas for the distillation of water using a combination of solar heater and thermal pump. It is desirable that a cooking stove, utilizing solar energy and suitable for large-scale production, should be designed for use in a country like India. The development of air-conditioning equipment driven by solar power is worth consideration as is the design of a flat-plate collector for driving a small engine. Perhaps the most profitable way of utilizing solar energy is through the media of plants, and it would therefore be worthwhile to investigate the design of a small steam engine of high efficiency using wood or other plant material as fuel.

CENTRAL ELECTRO-CHEMICAL RESEARCH INSTITUTE, KAPAIKUDI

THE Central Electro-Chemical Research Institute which was formally declared open by Dr. S. Radhakrishnan, Vice-President of India, on 14th January, 1953, is the tenth institution belonging to the network created by the Council of Scientific and Industrial Research, under the direction of Dr. S. S. Bhatnagar. Created for the rationalisation of industry, this network has been able to win the substantial support of Indian industrialists. The emergence of the Institute was largely made possible by the gesture of Dr. Alagappa Chettiar who offered a donation of Rs. 15 lakhs and a free gift of 300 acres of land for the Institute.

The Institute will have a number of major divisions dealing with electro-metallurgy and electric furnace products, electrolytic cells,

electro-deposition and allied processes, electrochemistry of gases, etc. Besides the usual laboratory services and general chemical measuring instruments, etc., certain special work facilities and equipment such as liquid air plant, X-ray diffraction equipment, spectrographic and metallographic equipment, a constant temperature room, micro-analysis apparatus, electrolytic cells for special purposes—for fluorine for example—apparatus for repair and standardisation of precision instruments, are also intended to be provided. Provision has already been made for a general workshop, a lecture theatre and a well-equipped library. Space provision has also been made for accommodating a Museum or to be more appropriate, an Exhibition of products and equipment of interest to electro-chemists.

LADY TATA MEMORIAL TRUST SCIENTIFIC RESEARCH SCHOLARSHIPS, 1953-54

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1953-54 commencing from 1st July, 1953. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognised research Institute or Laboratory on

a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trustees. Candidates can obtain these instructions and other information they desire from the Secretary, the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay 1. The last date for receipt of applications is 15th March, 1953.

CHROMOSOMES AND THE SPECIES PROBLEM IN THE GENUS VIBURNUM

E. K. JANAKI AMMAL

Botanical Survey of India, Calcutta

IN 1914 *Viburnum fragrans*, the most beautiful of all winter flowering shrubs, was introduced into European gardens. Reginald Farrer² found it growing wild in the barren hills round Kai Chow in S. Kansu, North China. As a cultivated plant it had a long history in China judging from the fine old specimens Farrer described as growing in every temple and palace and hamlet in Kansu. It was a Royal flower in Peking and reached common hands only with the fall of the Imperial dynasty. Several varieties of this rose-coloured Viburnum have arisen in cultivation of which a white form is in the collection at Wisley. The plants introduced into England came from Jo-ni, a little Tibetan village on the foothills of the Min Sa Alps. In 1932, Simonet and Miedzyrzeczk³ reported the chromosome number of *V. fragrans* as $x = 8$; $2n = 16$. This was a new basic number for the genus *Viburnum* in which Sax and Kribs⁴ had found only plants with $x = 9$; $2n = 18$. Yet a

third basic number $x = 10$ was found by Suguri⁵ in *V. odoratissimum* ($2n = 40$) of China and India, an evergreen species, otherwise closely related to *V. fragrans*.

I had occasion to examine two garden hybrids of *Viburnum* and their parents in connection with their description for publication in the Botanical Magazine. The first was *V. Bodnantense*, a cross between the Himalayan species *V. grandiflora* and *V. fragrans* of Kansu. It had $2n = 16$ chromosomes. I found that *V. grandiflora* had like *V. fragrans*, also $2n = 16$ chromosomes. The chromosomes of the two species paired normally in the hybrid *V. Bodnantense*, pollen fertility being as high as 100 per cent. in this hybrid. The second hybrid I examined was *V. Juddii*, a cross between the Japanese species *V. bitchiuense*, and the closely related Korean species *V. Carlesii*. *V. bitchiuense* had $2n = 16$ chromosomes and *V. Carlesii* $2n = 20$, while the hybrid *V. Juddii* had

TABLE I
Chromosome numbers in species of *Viburnum*

I. With Panicle inflorescence (Deciduous, rarely evergreen)		
Section THYROSOMA $x = 8, 10$		
	<i>2n</i> Distribution	
<i>V. fateus</i>	16 N.W. Himalayas, Kashmir	
<i>V. grandiflorum</i>	16 Himalayas, Bhutan	
<i>V. sieboldii</i>	16 Japan	
<i>V. suspensum</i>	16 Liukiu Islands	
<i>V. fragrans</i>	16 Kansu	
var. <i>alba</i>	32 Cult. Kansu	
<i>V. Henryi</i>	48 Hupeh, Szechuan, Yunnan	
<i>V. erubescens</i>	48 Szechuan, Hupeh, Nilgris, Himalayas	
<i>V. odoratissimum</i>	40 India, China	
II. With Umbellate inflorescence (Deciduous and evergreen)		
Section LANTANA $x = 8, 9, 10$		
<i>V. bitchiuense</i>	16 W. Japan	
<i>V. Mongolicum</i>	16 E. Siberia, Kansu	
<i>V. Carlesii</i>	20 Korea	
<i>V. buddleifolium</i>	20 C. China	
<i>V. utile</i>	18 C. China	
<i>V. lantana</i>	18 Europe, W. Asia	
<i>V. rhytidophyllum</i>	18 C. and W. China	
(Deciduous, rarely evergreen)		
Section ODONTOTINUS $x = 8, 9, 10$		
<i>V. feticidum</i>	16 W. China	
var. <i>rectangulatum</i>	16 Szechuan	
<i>V. Wrightii</i>	16 Japan	
<i>V. lobophyllum</i>	18*, 20, 22 C. and W. China	
<i>V. acerifolium</i>	18 N. America	
<i>V. betulifolium</i>	18 C. and W. China	
<i>V. ovatifolium</i>	18 W. China	
<i>V. dentatum</i>	54 N. America	
(Deciduous)		
Section PSEUDOPULUS $x = 9$		
<i>V. tomentosum</i>	18 China, Japan	
var. <i>mariesii</i>	18 Cult.	
var. <i>sterile</i>	18 Cult.	
Section OPULUS $x = 9$		
<i>V. opulus</i>	18 Europe, N. Africa, N. Asia	
<i>V. Sargentii</i> *	18 N.-E. Asia	
<i>V. trilobum</i>	13 N. America	
Section LENTAGO $x = 9$		
<i>V. lentago</i>	18 W.-N. America	
<i>V. nudum</i>	18 W.-N. America	
<i>V. prunifolium</i>	18 W.-N. America	
Section PSEUDOTINUS $x = 9$		
<i>V. alnifolium</i>	18 N. America	
<i>V. furcatum</i>	18 Japan	
(Evergreen)		
Section TINUS $x = 9$		
<i>V. cinnamomifolium</i>	18 W. China	
<i>V. Davidi</i>	18 W. China	
<i>V. Tinus</i>	36 S. E. Europe	

* Count by Sax

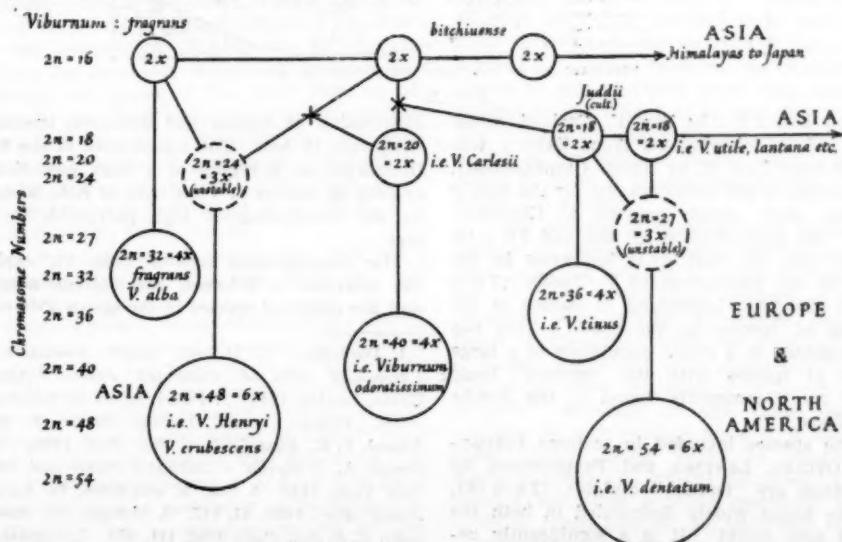
$2n = 18$, the number reported by Sax for all the species of *Viburnum* he examined. Thus by artificial hybridization it has been possible to synthesize a plant with a basic number $x = 9$, not only common in *Viburnum*, but dominant for many genera belonging to the family Caprifoliaceae.¹

A chromosome survey of *Viburnum* species grown at The Royal Horticultural Society Gardens, Wisley, Royal Botanic Gardens, Kew, and the Jardin de Plantes, Paris, was next undertaken to study the natural distribution of these three numbers, $x = 8$, $x = 9$, $x = 10$ and to see what relationship, if any, existed between these numbers and the classification of the genus. The results are presented in Table I in which the species I studied are arranged under the 8 sections based on the classification of Rehder.⁴

There are about 120 species included in the genus *Viburnum*. These are distributed from the arctic regions of Alaska and Labrador down to the warmer regions of Central America, N. Africa and Asia as far as Java. Only three species are European while more than half the total number belong to Asia. Taxonomically, *Viburnum* species fall into two main classes—those in which the inflorescence is paniculate and those in which it is umbellate. The species with paniculate inflorescence—the THYROSOMA Section of Rehder to which belong *V. fragrans* and *V. grandiflora*, are exclusively Asian, being distributed from the Himalayas to Japan and N. Asia. They are predominantly

deciduous and often precociously flowering, the exceptions being *V. odoratissimum* and *V. suspensum*. The basic chromosome number of all the deciduous species of this group is $x = 8$. Noteworthy is the fact that high polyploids occur in this section and they are found not only in the region of the Sino Himalayas—a region of high evolutionary activity in S.-E. Asia,³ but also on the isolated mountains of Peninsular India. Thus THYROSOMA evidently had once a wide and continuous distribution in the flora of Asia and is definitely a relic at the present time.

The white form of *V. fragrans* is the only tetraploid I found in this section and it probably arose in cultivation in China. The place of the evergreen *V. odoratissimum* with a "secondary" $x = 10$ basic number, in this section, is explained, when we examine the cytological picture presented by the umbellate flowered LANTANA and ODONTOTINUS sections, where also deciduous and evergreen species are included (see Table). The presence of a few related species with $2n = 20$ in areas of diploids ($2n = 16$) can only mean that they have arisen from them and the genetic relationships of *V. bitchiuense* ($2n = 16$) and *V. Carlesii* ($2n = 20$) the two parents of *V. Juddii* ($2n = 18$) can be explained if we consider *V. Carlesii* ($2n = 20$) as having arisen as a backcross between a chance triploid ($2n = 24$) of *V. bitchiuense* with the normal diploid ($2n = 16$) form, as follows ($2n = 24$) \times ($2n = 16$) = ($2n = 20$) (see Fig. 1):—

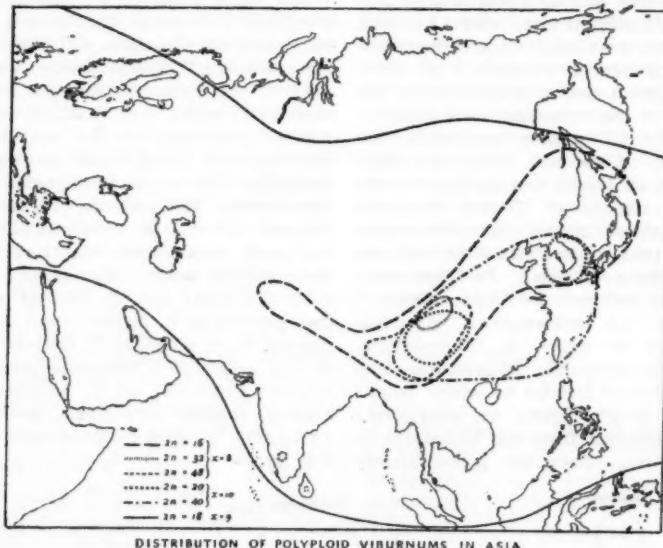
FIG. 1. Scheme of Chromosomes in *Viburnum*.

Triплоids are commonly produced in nature and abundantly in cultivation. Their presence in a population of perennial woody plants as *Viburnum* can be a constant menace to the stability of diploids owing to the continued hybridization that can take place between them and diploids. They are a source of perennial contamination of extra chromosomes and thus become a cause of new directives in the evolution of the species. In *V. lobophyllum*, a species closely related to *V. Wrightii* ($2n = 16$) three chromosomal forms were noted. The plant I

so far examined have only this "tertiary" basic number $x = 9$. The highest polyploid I found in this section, the hexaploid *V. dentatum* ($2n = 54$) is also N. American.

The evergreen *V. tinus* ($2n = 36$) is the only "tertiary" polyploid *Viburnum* I found in the old world. It is one of the few species of *Viburnum* that survived the Ice Age in Europe. It is very likely that varieties of this species with larger flowers which are known in cultivation will be found to be even higher polyploids.

In the accompanying Map, I have shown the



DISTRIBUTION OF POLYPLOID VIBURNUMS IN ASIA

FIG. 2.

examined had $2n = 20$ like *V. Carlesii*, while a plant of *V. lobophyllum* from Exbury was found to have $2n = 22$ by Enoch (unpublished). (This number is the dominant one for the family Rubiaceae, most closely related to Caprifoliaceae.) The plant studied by Sax had $2n = 18$. Thus we can say that what happened in the garden in the production of *V. Juddii* ($2n = 18$) has also been happening in nature in the evolution of species in *Viburnum*. This has finally resulted in a stable population of a large number of species with the "tertiary" basic number $x = 9$ commonly found in the family Caprifoliaceae.

All the species included in sections PSEUDOPULUS, OPULUS, LENTAGO and PSEUDOTINUS by the botanist are "tertiary" diploids ($2n = 18$). They are found widely distributed in both the old and new world. It is a significantly remarkable fact that all the American *Viburnums*

distribution of diploid and polyploid species of *Viburnum* in Asia. The significance of the Sino-Himalayas as a region of a high evolutionary activity in species of *Viburnum* in Asia is shown by the distribution of high polyploids in that area.

The diagrammatic scheme (Fig. 1), explains the relationship between chromosome numbers and the origin of species in the genus *Viburnum*.

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STUDIES IN ANCIENT INDIAN MATERIALS AND INDUSTRIES

A Pottery Glaze of Kushana Period from Khokrakot Mound

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INTRODUCTION

In connection with the studies initiated in this laboratory on ancient Indian materials and industries belonging to proto-historic and historic periods, a glazed pot-sherd from Khokrakot mound⁴ in Rohtak District was found to be of much interest as it provided an authentic specimen of glaze of the Kushana period (1st-3rd centuries). As the author is not aware of any published data on Indian glaze samples of comparable age, it was thought desirable to carry out a complete chemical analysis of the sample in order to determine its composition and the technique of colouring.

Incidentally it may be remarked that Khokrakot has yielded a vast collection of ancient coin moulds and other important archaeological material which have thrown a flood of light on coining technique in ancient India.⁵

EXPERIMENTAL

The glazed sherd has a chocolate-brown body and represents part of a coarse thick ware, the concave surface of which carries a layer of dirty brownish green glaze of 0.5 to 1 mm. thickness. The glaze shows crackle but is adhering very firmly to the surface of the sherd. For the preparation of a sample for chemical analysis the glaze was chipped off the body very carefully and traces of the body material adhering to the glaze were removed before powdering the sample for quantitative estimation. It had the following percentage composition : SiO_2 , 61.76; Fe_2O_3 , 5.07; FeO , 0.82; Al_2O_3 , 14.77; MnO , 0.04; CaO , 2.29; MgO , 2.13; Na_2O , 9.73 and K_2O , 4.12. Total, 100.73.

The chemical analysis shows that it is not a phosphate glaze and it is free from lead and

barium. Early Egyptian¹ and other Middle Eastern glazes are also free from barium and phosphate, the addition of which is a later development in the technique of glass making and glazing. Ancient Chinese glasses (550 B.C.) have been found to contain both barium oxide and lead oxide.⁵ The present specimen, therefore, represents an ordinary soda-lime glaze containing an appreciable amount of potash and a very high proportion of alumina. Addition of alumina prevents devitrification of glass, and produces a harder, durable, and more elastic glass.^{6,7} Alumina in excess of 4%, however, is not a desirable constituent of glass of excellent working quality, and the amount of 14.77% found in this sample is, therefore, unusually high. The colour of this glaze is due to iron oxides.

As the manufacture of glass is not far removed from that of glaze, and since chemically there is no difference between the two, it is interesting to compare the chemical composition of this glaze with the composition of earlier glass specimens of 4th-3rd century B.C., i.e., the glass specimens unearthed at Taxila. From published analyses of Taxila glasses,⁸ it is seen that no glass from Taxila shows such a high alumina content. In other respects, its composition is similar to that of Taxila glass. The alkalies are present to the extent of 13.85%, but the alkaline earths, lime and magnesia, account for only 5.42% of the sample. If the oxides, R_2O_3 are added to silica, it is seen that 81.60% of acidic oxides are present.

In the absence of chemical data on the composition of glazes of Kushana period from other sites, it is not possible to make a comparative general study of the glaze industry of this age. Recently some glazed pot-sherds have been found by the author from the glass factory site of Kopia, which has been dated tentatively by Nagar⁹ to circa 5th century B.C., on stylistic grounds. Although no age value should be attached to such surface finds, it is likely that these glazed sherds might be assignable to Kushana times, i.e., 1st-3rd centuries. The chemical examination of these specimens is likely to throw much light on the technique and composition of glazes of this period, and on the

* There is a series of mounds covering an extensive area in the immediate outskirts of the modern city of Rohtak (Long. 76°35' E.; Lat. 28°54' N.) in the East Panjab. One of these mounds, in the immediate neighbourhood of the city, has long been preserved as a protected monument by the Archaeological Survey of India,¹ and is known as Khokrakot mound. Rao Bahadur K. N. Dikshit,² late Director-General of Archaeology in India, has concluded from an examination of the surface finds that Khokrakot was in occupation upto the Kushana period.

question of the development of the glaze industry from 4th-3rd century B.C., to 2nd-3rd century A.D. This work is in progress.

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Coins in Ancient India (Numismatic Society of India, 1945). 4. Lucas, A., *Ancient Egyptian Materials and Industries*, 1934, p. 418. 5. Beck, H. C., and Seligman, C. G., *Nature*, 1934, **133**, 982. 6. Morey, C. W., *The Properties of Glass*, 1938, p. 64. 7. Hodkin, F. W., and Cousen, A., *A Text-book of Glass Technology*, 1925, p. 106. 8. *Annual Report of the Archaeological Survey of India, 1922-23*, p. 158; 1925, p. 43. 9. Nagar, M. M., *Amrita Bazar Patrika*, Allahabad, 14th Aug. 1949.

RAPTAKOS MEDICAL FELLOWSHIP AWARDS

THE Raptakos Medical Research Board Fellowships for the year 1953 have been awarded to the following candidates for research work in subjects mentioned against their respective names:—Mr. D. V. Rege, University Department of Chemical Technology, Bombay—Role of Folic acid and vitamin B₁₂ in nucleic acid metabolism; Mr. M. Bhimasena Rao, Indian Dairy Research Institute, Bangalore—Milk diets in relation to

Infantile Cirrhosis; Mrs. Shanta Savur Srinivas Rao, Haffkine Institute, Parel, Bombay 12—Iso-lation and the study of biological properties of the therapeutically important constituents of the Cobra and Russell's Viper venom; Dr. Shyam Kumar Vaish, Indian Veterinary Research Institute, Izatnagar—Diet and its relation to blood and tissues electrolytes.

CENTRAL LEATHER RESEARCH INSTITUTE, MADRAS

THE Central Leather Research Institute, which was inaugurated by Shri T. T. Krishnamachari, Central Minister for Commerce and Industry, on 15th January 1952, is the result of co-operation by many interests. The Government of Madras made a gift of nearly 84 acres of land in the Guindy area and also bore the cost of procuring and reclaiming it. The leather industry has made so far contributions amounting to nearly Rs. 1.21 lakhs and further support is expected. Rs. 35.5 lakhs has been sanctioned for buildings and equipments and the annual recurring cost is expected to be Rs. 3.5 lakhs.

Research, training and dissemination of technical knowledge to the leather industry are the three-fold function of the Institute. Research in the Institute can be classified into three broad categories. The first is fundamental work comprising research on the histology of hides and skins, physical structure and properties of hide and skin fibres, chemical constitution of hide and skin proteins. Next comes applied work including research on the application of chemistry, physics, bacteriology, microscopy and other branches of science in tanning and production of leather, control processes including study of the mechanism of vegetable tannins, mineral tanning agents, discovery of new tan-

ning agents, tanning auxiliaries and tanning processes. Lastly, there is development research implying investigations on processes of tanning and manufacture of leather auxiliaries practised in western countries to adapt them to Indian raw materials and conditions, pilot plant and extra-mural demonstrations of processes to industrial concerns, trials of new tanning auxiliaries and testing their performance in actual industrial manufacture.

The model tannery of the Institute has been equipped with a complete set of tanning machinery so that researches on leather manufacture may be carried up to a semi-commercial scale and trainees can get the advantages of working with intimate knowledge of demand conditions, production problems and consumer acceptance.

The Institute will form the nucleus for the dissemination of technical education to Indian leather industry including the issue of technical bulletins, contributions of articles to scientific and leather trade journals and answering of technical enquiries, etc. This work has already been started and a technical bulletin is being issued monthly. Technical enquiries received from different parts of India are also being replied to.

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BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY

THE opening ceremony of the new building of the Birbal Sahni Institute of Palaeobotany at Lucknow on 2nd January by the Prime Minister of India is the culmination of a fond dream of its founder, who did not live to see the fulfilment of his dream. The idea of creating a palaeobotanical institute has been in Professor Sahni's mind from as early as 1930, but could not be put into concrete shape because of the lack of financial support. However, in 1946 he resolved, together with his wife, Mrs. Savithri Sahni, to bring these plans to realisation and to begin on a small scale and with private resources.

In September 1948, the institute received the gift of an estate adjoining the University of Lucknow from the U.P. Government and also financial assistance from both this Government and the Government of India. Plans were laid for erecting a new modern building for the Institute, and its foundation-stone was laid by Pandit Jawaharlal Nehru on 3rd April 1949. Within a week after this function, the Institute suffered the heaviest loss that could befall it—Professor Sahni breathed his last on 10th April. However, by the efforts and untiring work of Mrs. Sahni, the co-operation and support of Professor Sahni's pupils and collaborators and the sympathetic interest taken by the Central

Government and in particular by Dr. S. S. Bhatnagar, the Institute continued to work and prosper and with the opening of the new buildings, the Institute can be said to have tided over its critical period.

Declaring the Institute open, Pandit Nehru paid glowing tributes to the late Professor Sahni, and mentioned that Professor Sahni was not only an internationally recognized expert in his own field, but also a leading personality in the scientific life of India. He expressed the hope that the Institute would fulfil the ambition of Professor Sahni of establishing an International Centre of Research in Palaeobotany in India.

This Institute is unique in the whole world, in that it is the only one which is devoted solely to investigations on palaeobotany. The present Director is Dr. O. A. Höeg, former Professor of Botany, University of Oslo, Norway, who joined the Institute in 1951. In addition to the laboratories, the Institute houses its own library consisting principally of Professor Sahni's collection of journals and reprints. There is an excellent museum exhibiting the various sides of palaeobotany, what fossil plants are, how they are preserved and how their study is applied for obtaining a geological time table. We wish the Institute all success in its activities.

NEW FIELDS OPENED UP IN ELECTRONICS

A NEW device called 'transistor' will make possible in the near future improved new-type radios, telephone apparatus and other types of electronic equipment that now use vacuum or electron tubes.

The transistor, which was developed by the Bell Telephone Laboratories in the United States, does the same kind of electrical work as a vacuum tube. The transistor consists of a tiny piece of germanium connected to wires and imbedded in a piece of plastic about the size of a pea. In this particle of germanium electrons do the same type of work that they do in a vacuum tube. It is believed that transistors will soon be used in tiny radios no bigger than a

watch that will operate indefinitely on one set of batteries, in telephones with built-in amplifiers, and in television sets whose tubes may not need renewal.

Several thousand transistors can be operated on the power needed for a single vacuum tube. Other advantages of the transistor are that they do not generate intense heat when in operation, as do vacuum tubes, and that they will last indefinitely. Most vacuum tubes have a life of only a few thousand hours. Transistors that are probably capable of operating continuously for more than 100,000 hours have already been made in the laboratory.

LETTERS TO THE EDITOR

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REMARKS ON THE CONSISTENCY EQUATIONS OF FINITE STRAIN

SETH¹ proved that if s_{ij} are the components of finite strain, then the consistency conditions reduce to the vanishing of Riemann-Christoffel tensors formed from the metric

$$g_{ij} = \delta_{ij} - (1 + s_{ij}) s_{kl} \quad (1)$$

i.e.,

$$\begin{aligned} R_{ikl}^n &= \frac{\partial}{\partial x_k} \left\{ \begin{matrix} n \\ li \end{matrix} \right\} - \frac{\partial}{\partial x_i} \left\{ \begin{matrix} n \\ lk \end{matrix} \right\} + \left\{ \begin{matrix} n \\ si \end{matrix} \right\} \left\{ \begin{matrix} s \\ lk \end{matrix} \right\} \\ &\quad + \left\{ \begin{matrix} n \\ sk \end{matrix} \right\} \left\{ \begin{matrix} s \\ li \end{matrix} \right\} = 0 \end{aligned} \quad (2)$$

$\left\{ \begin{matrix} n \\ li \end{matrix} \right\}$ being the usual affinity given by

$$\left\{ \begin{matrix} n \\ li \end{matrix} \right\} = \frac{1}{2} g^{ns} \left(\frac{\partial g_{ls}}{\partial x_i} + \frac{\partial g_{si}}{\partial x_l} - \frac{\partial g_{li}}{\partial x_s} \right) \quad (3)$$

Several other authors,² have also obtained such results.

This result brings to light the following facts of theoretical interest:

(1) Since in three dimensions the number of contracted and uncontracted Riemann-Christoffel tensors are the same and further as they are connected by linear relations it follows that the vanishing of the contracted Riemann-Christoffel tensor can equivalently be taken as the consistency equations. Now, remembering that the field equations in the gravitational theory of relativity are the contracted Riemann-Christoffel tensors equated to zero it follows that the consistency conditions are the three dimensional analogue of the field equations in relativity.

(2) Since the Riemann-Christoffel tensors follow the Bianchi identities, the consistency conditions are related to one another by the relations

$$R_{ikl; i}^n + R_{kil; i}^n + R_{ilk; i}^n \quad (4)$$

where semi-colon (;) denotes covariant differentiation.

As a first approximation we have

$$\frac{\partial E_{xx}}{\partial x} + \frac{\partial E_{yy}}{\partial y} + \frac{\partial E_{zz}}{\partial z} = 0, \text{ etc.} \quad (5)$$

where

$$\left. \begin{aligned} E_{xx} &= \frac{\partial^2 \rho_{xx}}{\partial y \partial z} + \frac{\partial^2 \rho_{yy}}{\partial x^2} - \frac{\partial^2 \rho_{yy}}{\partial x \partial y} - \frac{\partial^2 \rho_{zz}}{\partial x \partial z} \\ E_{yy} &= 2 \frac{\partial^2 \rho_{xy}}{\partial x \partial y} - \frac{\partial^2 \rho}{\partial y^2} - \frac{\partial^2 \rho_{yz}}{\partial x^2} \end{aligned} \right\} \quad (6)$$

(ρ 's being the components of strain)

The identities (5) hold independent of the fact that

$$E_{xx} = 0, E_{yy} = 0, \text{ etc.}$$

which form the consistency equations of the small strain theory.

Dept. of Mathematics, G. BANDYOPADHYAY.
Indian Inst. of Technology,
Kharagpur,
November 19, 1952.

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IMPROVEMENT OF CORNU'S METHOD FOR DETERMINING ELASTIC CONSTANTS

In the so-called Cornu's method for the determination of the elastic constants of transparent substances, the theory holds only for a plane beam, while in practice we are confronted with beams which are not plane. In the present note methods are suggested to eliminate the errors due to the curvature of the beam. The very small effect of the weights of the beam and the hangers, on bending, has been neglected.

Consider a beam having initial longitudinal and transverse radii of curvature R_0 and r_0 , and let these be altered to R and r when a bending moment G is applied to it. Then we have the following relations¹:

$$G = YAK^2 (1/R - 1/R_0) \quad (1)$$

$$\sigma = (1/r - 1/r_0)/(1/R - 1/R_0), \quad (2)$$

where the symbols have their usual meanings.

The two radii of curvature (R and r) can be measured by forming interference fringes² between the horizontal surface of the beam and a test plate.

Young's modulus can be calculated by eliminating the initial curvature from the equations by either of the following two methods: (i) If R_1 and R_2 be the two longitudinal radii of curvature when bending couples G_1 and G_2 are applied to the beam, then we have from equation (1)

$$G_1 - G_2 = YAK^2 (1/R_1 - 1/R_2) \quad (3)$$

(ii) Let R'_1 be the longitudinal radius of curvature with a bending couple G and R'_2 be its value with the same couple when the beam is reversed (initial curvatures change sign). Then, we have

$$2G = YAK^2 (1/R'_1 + 1/R'_2) \quad (4)$$

The equations for the Poisson's ratio under the same conditions are:

$$(i) \sigma = (1/r_1 - 1/r_2)/(1/R_1 - 1/R_2) \quad (5)$$

$$(ii) \sigma = \frac{(1/r'_1 + 1/r'_2)}{(1/R'_1 + 1/R'_2)} \quad (6)$$

For considerable improvement in the sharpness of the fringes the authors suggest that the beam and the test plate should be silvered (reflecting coefficient about .95) and the fringes be viewed or photographed in transmission.

The authors acknowledge their thanks to Dr. K. Majumdar for his interest in the investigation.

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Allahabad,
September 16, 1952.

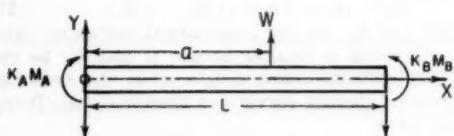
1. Morley, *Strength of Materials* (Longmans, Green & Co., London, Toronto and New York), 1940, p. 405. 2. Newman and Searle, *The General Properties of Matter* (Edward Arnold Co., London), 1949, p. 119.

PARTIALLY FIXED BEAMS

The so-called fixed beams are actually only partially fixed at their ends. In several cases it may be possible to assume ideal fixity and proceed with the design without making any appreciable error. However, in other cases when the fixities are far from ideal, it is essential to take the partial fixities into account, if the accurate analysis and design are needed.

Recently, Lothers¹ obtained elastic restraint equations for semi-rigid connections of specific types. The following method is more general and can be applied in general to any type of end fixity.

The coefficient of end fixity can be defined as the ratio of actual bending moment at a partially fixed end to the bending moment at the same end in case of ideal fixity. As an example, with 0.8 and 0.9 as the coefficients of end fixity at the left and right ends respectively and load at 0.6 span we find that the bending moment under the load is increased by over 14% compared to calculations made assuming ideal fixity, although the corresponding increase for shear is less than 1%.



In the above figure K_A and K_B are the partial end fixity coefficients ($0 < K_A \leq 1$, $0 \leq K_B < 1$) and M_A and M_B are the end moments when the beam is rigidly fixed. The beam is assumed to be of a uniform cross-section. Then the bending moment under the load M_w , the shear just to the left of the load S_L , the shear just to the right of the load S_R and deflection under the load Y_w are given by,

$$M_w = K_A M_A + \frac{(K_B M_B - K_A M_A)a}{L} - \frac{W a (L-a)}{L} \quad (1)$$

$$S_L = \frac{K_B M_B - K_A M_A}{L} - \frac{(L-a)W}{L} \quad (2)$$

$$S_R = \frac{K_B M_B - K_A M_A}{L} + \frac{aW}{L} \quad (3)$$

$$Y_w = \frac{a}{LEI} K_A M_A \left(\frac{aL}{2} - \frac{a^2}{6} - \frac{L^2}{3} \right) + K_B M_B \left(\frac{a^2}{6} - \frac{L^2}{6} \right) + \frac{W(L-a)}{3} (La-a^2) \quad (4)$$

where E is Young's Modulus for the material of the beam and I is the moment of inertia about the neutral axis of the cross-section of the beam.

$$\text{Since } M_A = \frac{Wa(L-a)^2}{L^2} \text{ and } M_B = \frac{Wa^2(L-a)}{L^2}$$

it is evident that M_w , S_L and Y_w are functions of three variables, namely, K_A , K_B and a/L , if W is considered as a unit load. Hence nomograms can be constructed with K_A , K_B and a/L as independent variables and M_w , S_L , S_R and Y_w can be read off these nomograms for any given set of values of K_A , K_B and a/L .

These nomograms can be used to determine the actual coefficients of end fixity of any given beam, as solution of two simultaneous equations in K_A and K_B will in general lead us to the specific values of K_A and K_B for the beam under consideration.

In practice, we can accurately measure the normal stresses due to bending by means of electrical strain gauges. For a given load W acting at a known point a/L , the normal stress measured under the load gives us the value of bending moment M_w ; in other words, one equation in K_A and K_B . Similarly, the second equation can be got with load at some other point and these two equations can be solved for K_A

and K_B . Alternately, two deflection experiments or one bending stress measurement and another deflection measurement will give us the required equations to solve for K_A and K_B . Once the end fixities are known, either the equations (1), (2), (3), (4) or the nomograms can be used for an accurate design.

The authors wish to thank Prof. O. G. Tietjens for his suggestions and for his permission to publish this note.

Dept. of Aeronautical Engg., C. V. JOGA RAO.
Indian Inst. of Science, J. V. RATTAYYA.
Bangalore,
December 1, 1952.

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ON THE OCCURRENCE OF SIDEROLITES SP. AND GLOBOTRUN- CANA cf. ARCA FROM THE UPPER CRETACEOUS OF PONDICHERRY, SOUTH INDIA

Fossils from Pondicherry have been studied by Forbes, E.¹, d'Orbigny, A., Blanford, H. F.², Stoliczka, F.³, Warth, H.⁴ and Kossmat, F.⁵

Kossmat,⁶ in 1897, after a detailed study of the stratigraphy and palaeontology of the cretaceous deposits, divided them into three main divisions, the lowermost Anisoceras beds (Valudayur beds) overlain successively by the Trigonecaria beds and Narinea beds. The uppermost he referred to the Danian and the two lower ones to Upper Senonian.

During a recent visit to this area the author made a collection of the fossils of Upper Cretaceous and Eocene beds. The occurrence of Siderolites sp. (Fig. 1) and Globotruncana cf.

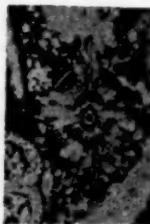


FIG. 1. Siderolites sp., $\times 13$. FIG. 2. Globotruncana cf. arca, $\times 80$

arca (Fig. 2) was noted in thin sections of the rock from the Upper Cretaceous beds. The rock is a hard, fine-grained, calcareous sand-

stone with shells of gastropods and bivalves. It is of bluish brownish colour and is referable to the Anisoceras beds (Valudayur beds) of Kossmat.

This is the first report of these genera from the Upper Cretaceous of Pondicherry. Except for an undescribed species of *Siderolites* from the Trichinopoly area reported by Rao,⁷ this genus has not hitherto been recorded from the Indian region.

A detailed description of these species will be published elsewhere.

I am highly indebted to Prof. S. R. Narayana Rao for his guidance.

Dept. of Geology,
Lucknow University,
Lucknow,
August 18, 1952.

R. S. SHARMA.

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A PRELIMINARY NOTE ON THE MIOCENE BEDS OF KATHIAWAR, WESTERN INDIA

SINCE the pioneer work of Fedden¹ in 1884, little has been added to our knowledge of the Tertiary geology of Kathiawar. We visited Kathiawar in February, 1952, and mapped the area around Bhogat ($69^{\circ} 14' : 21^{\circ} 59'$) and Bhatia ($69^{\circ} 16' : 22^{\circ} 6'$) in western Kathiawar and made a palaeontological collection from the beds occurring there. A preliminary investigation has revealed that the beds occurring in this region which Fedden described as Gaj, consist of two formations: an upper one which is post-Gaj in age and a lower one which is Burdigalian in age and may be the equivalent of the upper Gaj of Sind.

The fossiliferous rocks are confined to a narrow belt of 7 to 10 miles along the coast. The outcrops are met in creeks and nullahs. The beds show a very gentle dip up to 7° towards the coast. The sequence of rocks met with is as follows:—

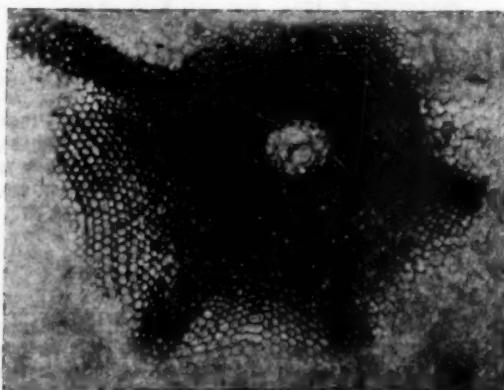
5. Dwarka beds of Fedden. White shaly limestones with fragments of shells and corals, found on the cliffs near the coast.
Age: Post-Pliocene.

4. Orbiculina-bearing beds of Bhogat. Buff-coloured argillaceous limestones crowded with foraminifers among which the following occur: *Orbiculina malabarica*, *Trybliolapidina* sp., *Miogypsina* sp., *Astrotrillina howchini* and *Gypsina globulus*. Some calcareous algae also occur. Age: Vindobonian.

3. Miogypsina-beds of Bhatia. Hard brownish limestones weathering red and crowded with tests of foraminifers. *Miogypsina* sp., *Miogypsinoides* sp., and *Astrotrillina howchini* are present. No Lepidocyctines were noticed here. Some calcareous algae are also present. Age: Burdigalian.

2. Laterite beds.

1. Deccan traps.



Lepidocyctina (Trybliolapidina) sp. Equatorial section showing stellate test and the embryonic apparatus with the nepionic chambers. Loc. Bhogat, $\times 22$.

Foraminiferal limestones of bed No. 4 and 3 were described by Fedden as Gaj beds. The foraminifers of the bed No. 4 indicate that it is Vindobonian in age and therefore a post-Gaj formation. Bed No. 3 is Burdigalian and probably the equivalent of upper Gaj.

Carter² in 1857 recorded *Orbiculina malabarica* from Kathiawar. The subgenus *Trybliolapidina* which characterizes bed No. 4 is being recorded here for the first time in India. It is a well-known Indo-Pacific form. This subgenus which resembles *Nephrolepidina*, is restricted to Vindobonian (Glässner³). It is characterized by a stellate test and by the presence of nepionic chambers.^{4,5,6,7} *Nephrolepidina* is not found in these beds. The faunal assemblage as a whole shows a close affinity to that of the Indo-Pacific region.

Bed No. 3 differs from the above in faunal contents as well as in lithology. The absence of *Trybliolepidina* sp. and *Orbiculina malabarica* and presence of *Miogypsinoidea* sp. and *Miogypsina* sp., indicates that the bed cannot be younger than Burdigalian.

Eames⁸ has recently stated that Middle Miocene beds are absent in Western India. The present discovery of *Trybliolepidina* from Kathiawar proves the presence of Vindobonian (Middle Miocene) beds here.

Detailed work is in progress and results will be published elsewhere.

We are grateful to Prof. S. R. Narayana Rao for his guidance and encouragement.

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Lucknow,
September 3, 1952.

A. K. CHATTERJI.
D. L. SAH.
KRISHNA MOHAN.
V. V. RAO.

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3. Glässner, M. F., *Proc. Roy. Soc. Vict.*, 1943, n.s. **55**, 41-80.
4. Crespin, L., *Ibid.*, 1943, n.s. **55**, Pt. II., 157-80.
5. —, *Journ. Pal.*, 1950, **24**, 4, 421-29.
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MONTICELLITE FROM THE CRYSTALLINE LIMESTONES OF BORRA, VISAKHAPATNAM DISTRICT

AROUND Borra ($18^{\circ} 17' - 83^{\circ} 03'$) in the agency tracts of Visakhapatnam District occur bands of crystalline limestone associated with khondalites. The village has come into prominence on account of the beautiful caves and caverns which are found in its environs and which contain impressive stalactites and stalagmites.

In connection with a systematic geological investigation of the area, various samples of crystalline limestone and marble were collected. While most of them are whitish, others exhibit various shades of light grey, very faint greyish green, dark grey and bluish grey colours. In some of the whitish varieties, there occur as disseminations slender prismatic crystals or oval grains, colourless to grey and bluish grey in colour and varying in length from a fraction of a centimetre to nearly one-and-a-half centimetres. The crystals are translucent to transparent with a vitreous lustre and breaking into bits nearly perpendicular to the length. The mineral has the crystal form of an olivine and has a hardness of about 5 and specific gravity of about 3.

In thin section, the crystalline limestone is mostly made up of calcite and dolomite and has in addition some monticellite and a few specks of sphene. Monticellite is colourless and has the characteristic outline of an olivine, elongated parallel to c (Fig. 1).



FIG. 1. Monticellite Crystals in Marble, $\times 18$.

The crystals are generally cracked. The relief of the mineral is high but the birefringence is rather low for the common olivine. In some cases, there is alteration along the margins and cracks to colourless serpentine. A few small slender acicular crystals are found as inclusions in the mineral and they appear particularly conspicuous under crossed nicols. While most of them are colourless, a few have a very faint bluish tint. The mineral which forms these crystals has a high birefringence and an oblique extinction and in all probability is tremolite.

The microscopic characters of the monticellite as determined with Federov's Universal Stage are recorded below:

Optically negative, biaxial with a large optic axial angle ($2V$) of $76^{\circ} \pm 1^{\circ}$, optic axial plane being parallel to (001). The birefringence (as measured with Berek's compensator) is 0.013.

The mineral is thus different from the common olivine which is mostly green in colour and has a higher birefringence.

Though Fermor^{1,2} has described forsterite from the marbles of Sausar Series, this is the first reported occurrence of monticellite-marbles

in the Archaean of South India. The occurrence of monticellite, a calcium magnesium orthosilicate, in the crystalline limestones and marbles, indicates that the original sediments were silica-poor, a fact confirmed by the paucity of silicate minerals in them.

A detailed study of the granular limestones and marbles is in progress and will be published elsewhere.

Dept. of Geology,
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November 7, 1952.

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1. *Rec. G.S.I.*, 1926, **59**, 78. 2. —, *Ibid.*, 1920, **51**, 20.

INTERFACIAL SURFACE TENSION AND COMPLEX FORMATION IN SALT SOLUTIONS

NAYAR AND CO-WORKERS^{1,2} have shown the formation of complexes in various systems, such as $Pb(NO_3)_2 \cdot KNO_3 \cdot H_2O$, by the presence of anomalous values of physical properties at concentrations corresponding to their formation. Similar peaks are also found in the curves obtained by plotting interfacial tension of liquids having unstable H-bond ring structure against the concentration of any one variant. Using the drop number method,³ the authors have found peaks in the surface tension-concentration curve with the system $CdI_2 \cdot KI \cdot H_2O$, corresponding to the complexes $CdI_2 \cdot 2KI$ and $CdI_2 \cdot KI$. Further, seven complexes in case of the system $HgCl_2 \cdot KCl \cdot H_2O$, seven in $HgBr_2 \cdot KBr \cdot H_2O$ and three in case of the system $Pb(NO_3)_2 \cdot NaNO_3 \cdot H_2O$ seem to be formed. In other cases, the results of Nayar, et al., are confirmed. Auto-complex formation in case of salts like cadmium iodide, cupric chloride, etc., is evident from the results of such interfacial tension measurements. Experimental details of the study of all these systems with full discussion of the theory of reversal of electrical double layer at interface of liquids, referred to, will be published elsewhere.

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M. T. B. College, C. M. DESAI.
Surat,
October 1, 1952.

1. Nayar, et al., *Proc. Ind. Acad. Sci.*, 1948, **27A**, 284-360; Narasimha Murthy, *Ibid.*, 1950, **31A**, 160.
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ROLE OF MANGANESE IN THE BIOSYNTHESIS OF ASCORBIC ACID

FURTHER evidence of the intermediary role of manganese in the biosynthesis of ascorbic acid (Rudra⁴⁻⁵) has been obtained.

The increased synthesis of indophenol reducing substance by seedlings in suitable concentrations of manganese has been identified with true ascorbic acid by the biological method of Coward and Kassner.⁶ Other elements in similar concentrations are ineffective. That the increased synthesis, in presence of manganese, is not due to any protective action of the element on ascorbic acid has been found by following through its behaviour under identical conditions. In presence of manganese, the synthesised ascorbic acid consists of an increased amount of dehydroascorbic acid owing to the activation of ascorbic acid oxidase by manganese.

Signs resembling scurvy in guineapigs have been produced in rats and rabbits by putting them on a synthetic diet complete in other known essential principles but lacking in manganese. The signs became evident in the rat after 4 weeks and in the rabbit after 2 weeks on the diet. In addition to poor growth, scorbutic signs were evident not only by the much lowered contents of the vitamin (more or less of the same order as in guineapigs on scorbutic diet for an equal period) in the tissues but also by the histology of the tissues which have lesions resembling the lesions in scorbutic guineapigs reported by Hjärre and Lilleengen.⁷ These lesions produced in the first generation of manganese deficient animals cannot be confused with the lesions found by Pappenheimer⁸ in 20 per cent. of his vitamin E deficient mice who themselves were offsprings of parents who were deficient in vitamin E for 2 to 7 generations.

Young rabbits are extremely susceptible to manganese deficiency and many succumb within 2 weeks. High doses of manganese are toxic to animals as to plants. The enzyme isolated from *P. mungo* and rat jejunum⁹ is totally inhibited by 60 p.p.m. of manganese in the undialysed extract and almost inhibited by a similar concentration in the dialysed extract. Growth of rats is retarded by a not too high manganese diet which is also not relished by the animals like a too salty diet. The inability of Boyer, et al.,¹⁰ to demonstrate the synthesis of ascorbic acid was due to the high manganese content of the diet of supplemented rats. The histology of the lower incisors of manganese deficient and supplemented rats and rabbits are similar to the histology of vitamin C deficient and

supplemented guineapigs respectively. Judging by the Key and Elphick¹¹ standard guineapigs on scorbutic diet given injections of manganese with glucose have about the same degree of protection as animals given 0.5 mg. vitamin C daily. Guineapigs on scorbutic diet given manganese injections with glucose have a phosphatase distribution (Gomori's technique¹²) in the adrenal, jejunum and liver of the same order as in normal animals getting vitamin C whereas the phosphatase distribution in the corresponding tissues of scorbutic animals is lessened.

The non-synthesis of ascorbic acid in manganese deficient animals is not due to arrest of growth. Arresting growth by restricting calories intake does not interfere with ascorbic acid synthesis. Hopkins and Slater¹³ also demonstrated synthesis in fasting animals.

The present evidence does not militate against the observation of others on the role of B vitamins in ascorbic acid synthesis. The possibility is not remote that the co-enzymes of the oxidase systems contain some of the well-known B vitamins and manganese.

The author is indebted to Prof. R. A. Peters for hospitality in the Department of Biochemistry, University of Oxford, where part of this investigation was carried out. He is also grateful to Mr. E. Leach of the Department of Physiology and Dr. A. Robb-smith of the Radcliffe Infirmary, University of Oxford, for histological sections and criticism.

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Bihar,
July 30, 1952.

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CARBOHYDRATES OF AGAVE VERA CRUZ

It was reported previously from these laboratories that the surface underwood of *Agave vera Cruz* is a rich source of polyfructosans.¹ In the preparation of fructose* from this source, the raw material had to be subjected to several

treatments, essentially to free it from unwanted constituents, notably phenolic bodies and foam-forming substances. Even so, the resulting polyfructosan-rich material contained other water-soluble carbohydrates, among which evidence for the presence only of glucose and sucrose could be obtained by the traditional methods of sugar analysis. However, with the aid of paper partition chromatography, the underwood of *Agave vera Cruz* has now been shown to contain at least seven water-soluble carbohydrates.

Among the different techniques, the capillary ascent method gave the best results. Using filter-paper (Whatman No. 1; 40 cm. × 40 cm.), butanol : acetic acid : water (4 : 1 : 5), about 60 hours for developing and then spraying with benzidine-trichloracetic acid, a repeatable chromatogram, typical of Fig. 1, was obtained.

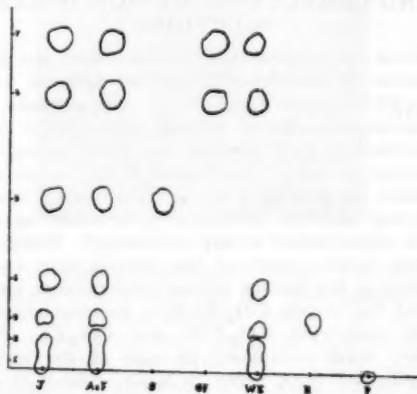


FIG. 1. Chromatogram of the Carbohydrates in *Agave vera Cruz*.

The test spots consisted of: The press juice (J); Polyfructosan precipitated from the press juice by stepwise treatment with ethanol upto 80% concentration (v/v) (P); Alcohol-soluble fraction, after removing the polyfructosan as above (_AF); Water-extract of the grated and dried material (WE); Reference spots: Sucrose (S); Glucose fructose mixture (GF); Raffinose (R).

It is clear that the material contains a polyfructosan (Spot 1), 3 other carbohydrates (spots 2 to 4), sucrose (spot 5), glucose (spot 6) and fructose (spot 7). From the optical density (visual) of the spots, it is confirmed that the polyfructosan (P) is the major constituent. Spot 2 and spot 3, just below the position of raffinose (R) and spot 4 just above it are yet to be identified. However, on spraying a guide strip with phloroglucinol-trichloracetic acid reagent, spots 2, 3 and 4 in common with spot 1

(and of course sucrose and fructose spots) showed up, indicating the presence of easily hydrolysable ketose residues in the carbohydrates corresponding to these spots. It will also be noticed that polyfructosan spot P has not been resolved by the developing solvent, confirming the homogeneity of this polyfructosan, as shown also by its chemical characteristics, details of which will be published elsewhere.

Our thanks are due to Dr. V. Subrahmanyam for his kind interest in the work.

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November 4, 1952.

* Patent under application.

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ROOT DEVELOPMENT IN LENS ESCULENTA MOENCH

WITH a view to find out the depth of cultivation and spacing necessary for sowing this crop, work on root development was started by the author in 1948. The results are presented in this paper.

Root development in three varieties of *Lens esculenta* Moench, namely, 4315-I, 4328-23 and 4318-4 was studied by digging the seedlings on days as noted in Table I.

TABLE I

Root system at different stages of development

Days after sowing	Root length in cm.	No. of secondary roots	Area covered (sq. cm.)
4	.37	..	..
5	1.20	..	..
6	1.60	..	..
7	1.70	..	..
8	2.80	..	..
9	3.10	..	..
10	3.50	..	..
11	4.00	..	..
12	4.10	..	..
13	5.00	..	..
14	5.00	..	..
15	9.90	2	..
30	14.50	14	37.8
63	16.80	35	285.5

From the above table it can be seen that the radicle emerges on the fourth day after sowing and continues to grow till the fourteenth day of sowing. On the fifteenth day two branches appear on the root. There may be

a difference of few hours in the appearance of these branches. They are alternate and form an angle of 45°. Length of the primary root at this stage is 9.9 cm. Roots are yellowish white in colour and are provided with root tips which are transparent white. One-month old plant exhibits a primary root measuring 14.5 cm. and with fourteen secondary roots. The root system at this stage covers an area of about 37.8 sq. cm. The root system of the 63-day-old plant, i.e., at the initiation of reproductive phase shows branches of the fourth order having about 35 secondary roots. Roots possess many bacterial nodules which begin to appear when the plant is 20 days old. At this stage, the root system covers an area of about 285.5 sq. cm. and the main root measures 16.8 cm. Lateral growth of the roots is nearly confined to a radius of 10.5 cm. Roots generally arise at an acute angle.

The present work shows that the root system of *Lens esculenta* Moench occupies the soil to a depth of about 17 cm. and its lateral growth covers a radius of about 11 cm. So it may be concluded that this crop requires a cultivation of about 7.0" deep and that the seeds should be sown about 4.5" apart in rows and the distance between rows may also be kept not below 4.5" to allow proper growth of the roots.

I am highly thankful to Dr. N. K. Anant Rao, for valuable guidance.

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September 3, 1952.

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MEIOSIS IN MOMORDICA DIOICA ROXB.

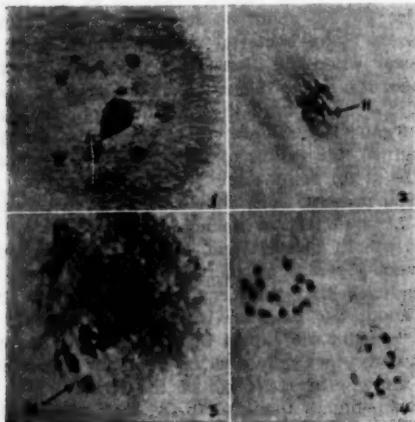
MEIOSIS in *Momordica dioica* does not seem to have been worked out. In other species of the genus *Momordica* such studies have been carried out, viz., in *M. Balsamina* $n=11$ has been recorded by Whitekar (1933)* and McKay (1931)† and in *M. charantia* $2n=22$ by McKay (1930)* and Yamaha and Suematsu (1936)† and Bhaduri and Bose (1947).

In the present studies meiosis was studied from smear preparations in two of the male plants of *M. dioica* selected from a population of 47 plants raised from seeds during 1949 in the Botanical Experiment Area at Sabour. Excellent preparations at all stages of meiosis were made by fixing the anther in acetic

* cf. Bhaduri and Bose, 1947.

† cf. Darlington and Ammal, 1945.

alcohol followed by smearing in aceto-carmine after mordenting the material with 4 per cent. iron alum. At diakinesis, 14 bivalents were distinctly observed, of which one was seen to be attached with the nucleolus (Fig. 1). Such a condition was observed in a number of pollen mother-cells. At I-Metaphase in the polar view, 14 bivalents were also distinctly seen. In some of the well spread I-Metaphase plates in side-views one of the pairs was observed to be heteromorphic (Fig. 2, H). It also showed a



FIGS. 1-4. Micro-photographs, meiosis in *Momordica dioica*.

FIG. 1. Late diakinesis with fourteen bivalents. One of the bivalents is seen attached with the nucleolus, $\times 950$.

FIG. 2. I-Metaphase (side view), showing a heteromorphic bivalent (H), $\times 1,450$.

FIG. 3. I-Metaphase (side view), showing a heteromorphic pair, disjoining earlier (H), $\times 1,450$.

FIG. 4. II-Metaphase (polar view), the upper half shows distinctly fourteen univalents, whereas the lower shows only thirteen univalents, one being out of focus.

tendency to disjoin somewhat earlier than the other bivalents (Fig. 3). At the end of the first division the chromosomes reconstitute the daughter nuclei and pass into the resting stage, developing a number of nucleoli and at this stage the maximum number of nucleoli observed was 4. But this stage was observed to be of short duration and the chromosomes remained somewhat contracted. The two chromatids in some of the chromosomes were actually seen to repel each other at ends, being only held together in the middle region, presumably at their centromeres.

At II-Metaphase 14 univalents were distinctly counted in each half, as are seen in Fig. 4 (upper half). In the lower half in the same plate one of the univalents was out of focus.

Pollen grain studies were made in the 7 male plants from the same population, as shown below :

Plant No.	Percentage of fertile pollen
No. 1	94.5
No. 2	57.9
No. 3	92.1
No. 4*	81.3
No. 5*	95.2
No. 6	86.2
No. 7	82.4

* Studied at meiosis.

It may be of interest to record that in plant No. 5, rarely giant and joint pollen grains were also observed.

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Sabour,
October 1, 1952.

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LIFE-HISTORY OF OCHROMA LAGOPUS SW.

Ochroma lagopus Sw., the balsa or cork wood (used for aeroplanes) belonging to Bombacaceae, is originally a native of S. America. A few trees are being cultivated successfully in the Anakapalli Agriculture Farm, Visakhapatnam District, wherfrom the material for the present investigation was obtained. The only previous embryological work in the family is that of Banerji¹ and Thirumalachar and Khan² on the development of the female gametophyte and floss in *Eriodendron anfractuosum* DC. and *Bombax malabaricum* DC. respectively.

The five stamens of the flower of *Ochroma* are united into a massive column on the surface of which are found the numerous transversely septate sinuous folds of anther lobes. In each fold, two anther loculi develop, which are subtended by two mucilage canals. The anther-

wall is 5-6-layered, of which the subepidermal layer develops into the fibrous endothecium and the innermost into the tapetum which is of the secretory type. The inner walls of the tapetal cells become cutinised. There is a marked secondary increase in the sporogenous cells. Microspore tetrads are tetrahedral and cytokinesis occurs by furrowing. The pollen grains are large, spherical, smooth-walled and triporate and are shed in the 2-nucleate condition.

There are numerous anatropous, bitegmic, crassinucellate ovules on axile placentae. The micropyle is zig-zag. Linear as well as T-shaped megasporangia occur of which the chalazal-most megasporangia functions and forms the 3-nucleate embryo-sac according to the normal type. The synergids are hooked and show filiform apparatus. The egg is much longer than the synergids. The polar nuclei fuse just before fertilisation by which time the antipodal degenerate. There are numerous large starch grains in the cytoplasm of the sac. The antipodal end of the embryo-sac is somewhat tubular due to its being invested by a socket of thick-walled nucellus cells which form a postament in the developing seed.

The style shows five tracts of transmitting tissue in line with the five loculi of the ovary, consisting of finger-shaped, thin-walled richly protoplasmic cells. The funicles are also lined by radially elongated cells with rich cytoplasmic contents and prominent nuclei. These develop into floss after fertilisation. Entry of the pollen tube is porogamous. The pollen tube which is about $10\text{ }\mu$ in width, gives off a number of short branches in the region of the micropyle and persists without collapsing till the embryo becomes a large globular mass. As it is surrounded by the starch-bearing integumentary cells, it seems to act as a channel for the passage of food materials to the developing embryo, as in Malvaceae.

Endosperm is of the nuclear type, and becomes cellular by the time the embryo is about 24-celled. In the mature seed the nucellus is completely absorbed. Embryo development conforms to the *Urtica* variation of the Asterad type. The mature embryo which is straight shows large fleshy cotyledons and a short suspensor. The palisade layer of the seed-coats is derived from the outer epidermis of the inner integument; outside this is a crystal layer. The funicle which becomes stout, persists in the seed and the floss developed from its epidermal cells helps in seed dispersal.

Embryologically, *Ochroma* differs from members of Malvaceae in a number of features like

secondary increase in the microspore mother-cells, smooth-walled triporate pollen grains, secretory type of anther tapetum, anatropous ovules, presence of starch grains in the cytoplasm of the embryo-sac, hooked synergids, development of postament, straight embryo, short suspensor, etc., and there seems to be no justification for treating the family Bombacaceae as a tribe of Malvaceae as Bentham and Hooker did.

My thanks are due to Prof. A. C. Joshi and Prof. J. Venkateswarlu for their kind interest in the work.

Dept. of Botany,
Andhra University,
Waltair,
September 17, 1952.

C. VENKATA RAO.

1. Banerji, I., *Proc. Ind. Acad. Sci.*, 1942, **16B**, 205-11.
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EFFECT OF BENZENE HEXACHLORIDE ON GROWTH OF SUGARCANE

BUZACOTT¹ observed that 'Gammexane' intimately mixed with soil caused no observable effect on the development of the shoot buds on cane sets germinating therein but there was an inhibition of both primary and secondary root development. McDougall² noted stunting of primary roots developing from cane sett under some conditions where they contacted B.H.C. Dick³ and Mungomery⁴ secured satisfactory germination of cane with B.H.C. dust. Wilson⁵ observed no damage whatever to the cane when B.H.C. alone was applied in the drill at planting but noticed failure of germination and poor growth when the fertiliser mixed with B.H.C. was applied. In this note are reported certain effects of B.H.C. observed at Pusa on germination, growth, and root development in sugarcane, since 1949.

Experiments were carried in pots in which the local soil was mixed uniformly with 10, 50, 100, 200 and 400 parts B.H.C. containing 5.5% gamma isomer (Gammexane P. 520) per million of soil and sets of Co. 453 variety were planted. It was observed that the growth of plants had practically stopped after formation of 4, 2 and 2 leaves and they dried up in the treatments containing 100, 200 and 400 P.P.M. of B.H.C. With 50 P.P.M. the mother shoot or its tillers survived till 24 weeks after which they dried. The heights of plants after 4 weeks of growth were progressively poorer in order of increas-

ing dosage of B.H.C. Striking differences were seen in the roots of these plants (Fig. 1). The



Decreasing concentration of B.H.C.

FIG. 1. Effects of B.H.C. on Sugarcane Roots.

set and shoot roots in the untreated plants were long and profusely branched and pointed at their tips. In 10 P.P.M. the roots were normal, but shorter. With increasing dosages of B.H.C. the roots became fewer, much shorter and their tips swollen into club-shaped woody structures.

This study stresses the need for caution in indiscriminate use of the B.H.C. compounds. Further studies with other crop plants and as to the mechanism of this effect are in progress.

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October 30, 1952.

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PARALLEL TESTS WITH CALCUTTA AND HEBBAL (BANGALORE) TOADS FOR BOVINE PREGNANCY

The recent publication of Rao and Krishnamurthy⁶ has led the present authors to communicate their findings on the parallel tests they were able to perform with the Calcutta and Hebbal toads during May-June and August this year. Prior to publication of this note, one of the present authors (J. L. B.) brought with him some Hebbal toads from Bangalore in May last through the courtesy of Dr. N. S. Krishna Rao. But before we could start our investigation, all the Hebbal toads died for totally obscure reasons; only 4 toads were left over for running parallel tests during May-June. In early August Dr. S. P. Ray-Chaudhuri of this Department, brought with him 25 Hebbal toads from Dr. N. S. Krishna Rao. Unfortunately, only 14 of them turned out to be males. Special care was immediately taken for their safe and sound housing, and none died before we could do at least one experiment with each of the 14 Hebbal toads.

For the series of parallel tests, 18 feces samples from different pregnant and non-pregnant (lactating and sterile) cows and males (bull

ISARIOPSIS GRISEOLA SACC. ON PHASEOLUS VULGARIS L.

A LEAF-SPOT disease of French beans (*Phaseolus vulgaris* L.) prevails during and after the rains in different parts of the Nilgiri plateau. Dark brown spots of varying sizes and shapes are found on the leaves. Blackish coremia develop on the lower surface of the spots. These measure 128 to 680 μ in length and 28 to 69 μ in thickness. They are composed of a bundle of parallel, brown, septate hyphae 4 to 6 μ thick. At the apices these hyphae diverge to form lighter-coloured conidiophores which are either curved or flexuous and septate. They measure 48-100 \times 4-6 μ . The conidia are formed singly at the tips of the conidiophores and are obclavate, straight or slightly curved, tapering towards the tip, one to five-septate (mostly three-septate),

and bullock) were collected, of which 7 samples came from the Bengal Veterinary College, Calcutta, and the rest from private owners. Each one of them was clinically confirmed afterwards. Since Rao and Krishnamurthy reported positive results in most cases, we concentrated our attention more on the non-pregnant and male cases.

The procedure (i.e., preparation of faecal solution, injection schedule, etc.) was followed in the same manner as described in our previous communications.^{1,2} It should be mentioned that in a few instances only we re-used some of those Hebbal toads which had survived the first test, after a good rest.

An analysis of the results of our investigation is presented in Table I. It will be apparent that the Hebbal toads reacted positively in all the instances. An initial 5 c.c. dose was enough for a good positive reaction in $\frac{1}{2}$ hr., only 5 reacting at the end of the first hour. On the other hand, the Calcutta toads never reacted positively, except in pregnant cases, up to a split-dose (5 c.c. each) administration of 20 c.c. volume of the same fecal solution. They gave consistent correct positives and negatives which are in consonance with our previously published results.¹⁻³

The quick response of the Hebbal toads prompted us to run a few parallel experiments with human urine specimens in August last. The results are also included in Table I. These data are too meagre to warrant any definite

conclusion. Nevertheless, the overall picture tempts us to question whether the Hebbal toads possess a sort of seasonal sensitivity in reference to gametokinetic reactions, since Rao and Krishnamurthy⁶ reported 12 negatives, most of which appear to be correct. Unfortunately, they did not mention the period when their experiments with 76 Hebbal toads were conducted, nor did they offer any annotation for the negatives. In the parallel series of tests, viewed in isolation, the Calcutta toads would be found to have reacted differently at the two places—Bangalore and Calcutta. But when both are taken together and viewed in the context of the entire situation, the Hebbal toads appear to be highly sensitive in that they reacted positively in every instance, be it cattle or human, pregnant or non-pregnant or males. And the period of experimentation may be said to cover May through August, although no test was done in July. We can, therefore, conclude that the Hebbal toads are refractory, if not useless, for 'pregnancy testing' at least for this short period.

The question of seasonal sensitivity in the Calcutta toads does not arise, since the efficiency and accuracy of pregnancy tests in human medicine with males of *Bufo melanostictus*, are well established in this laboratory¹ and elsewhere.^{1,5} More than 1,000 tests with human urine specimens and 250 with bovine faeces samples have to date been done routinely in this laboratory with ever-encouraging and satisfactory results. We have never encountered a false positive either in human or in bovine pregnancy tests. The results of tests reported by Rao and Krishnamurthy with the Calcutta toads in the parallel series seem somewhat disturbing, although a correct negative and a false negative have been recorded. Thus, the behaviour of the Calcutta toads at Bangalore seems paradoxical and is not easily explained, compared with our findings here. However, Rao and Krishnamurthy concluded that some substances, gametokinetic in reaction in the male toad, are present in the faeces of pregnant, non-pregnant and male cattle. They have further raised the question whether the feed of the cattle is responsible for the overall positive results. We have no adequate data before us either to support or to conflict with this suggestion. Our latest communication³ has briefly and partially answered the question of cattle fodder raised by Cowie.⁴ Now, even if we assume that the feed of the cattle may at certain places interfere with results, as presumably it did at Bangalore, may we not pose that it can be controlled for 'pregnancy testing' purposes?

TABLE I

	Hebbal toad				Calcutta toad			
	I	II	III	IV	I	II	III	IV
<i>Bovine faeces :</i>								
2 Pregnant	2	1	+	$\frac{1}{2}$	2	3	+	2 $\frac{1}{2}$
(2nd trimester)								
9 Non-pregnant	{ 6	1	+	$\frac{1}{2}$	9	4	-	-
(lactating, 16-3 mths.)		3	1	+		4		
1 Sterile	1	1	+	1	1	4	-	-
6 Bull	{ 5	1	+	$\frac{1}{2}$	6	4	-	-
1 Bullock		1	1	+		1		
<i>Human urine :</i>								
1 Pregnant (threatened abortion)	1	1	+	$\frac{1}{2}$	1	3	(+)	3 $\frac{1}{2}$
2 Non-pregnant	{ 1	1	+	$\frac{1}{2}$	2	4	-	-
1 Male		1	1	+		1		

I—No. of specimens. II—No. of dose (5 c.c.).
III—Reaction. IV—1st positive reaction at hour.
(+) Indicates weak positive (5-10 sperms).

We have not raised the question whether the difference in the gametokinetic reactivity of the two toads, Calcutta and Hebbal, is due to some physiological (reproductive) factors. We may, however, note in passing that the Hebbal toads can be told off from the Calcutta ones by the possession of a characteristic brick-reddish coloration on their somewhat smooth dorsum, although both apparently belong to the same species. On preservation this coloration tends to fade gradually to insignificance in the course of a few days. Whether these differences are varietal or specific or merely physiological, needs special investigation.

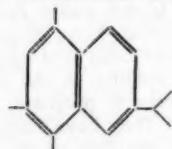
In the light of the above observations, further trial with locally available males of *B. melanostictus* is urged at different centres of Dairy Institutes in India to test the efficiency and adaptability of 'pregnancy testing' proposed by Bhaduri.^{1,2}

Our thanks are due to Dr. N. S. Krishna Rao and Dr. S. P. Ray-Chaudhuri for their courteous help.

University College of Science, J. L. BHADURI.
Dept. of Zoology, N. R. BARDHAN.
35, Ballygunge Circular Road,
Calcutta-19,
September 8, 1952.

1. Bhaduri, J. L., *Proc. 38th Ind. Sci. Congr.*, 1951, Pt. 2, 171.
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5. Nandkarni, S. M. and Broker, R. S., *Ind. J. Med. Sci.*, 1951, 5, 325.
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SYNTHESIS OF 2:4-DIMETHYL EUDALENE



ISOPROPYL BENZENE on methyl succinylation in nitro-benzene solution in presence of anhydrous aluminium chloride yielded β -(*p*-isopropyl benzoyl)- α -methyl-propionic acid, m.p. 118-19° C. (Found: C, 72.03; H, 7.68; $C_{14}H_{18}O_3$ requires C, 71.79; H, 7.69 per cent.). Inverse Grignard addition of methyl magnesium iodide to the methyl ester of the above keto acid, on dehydration and hydrolysis furnished γ -(*p*-isopropyl benzene)- α : γ dimethyl-vinyl acetic acid boiling between 145-48° C./1 mm. (Found:

C, 77.12; H, 8.53; $C_{15}H_{20}O_2$ requires C, 77.59; H, 8.62 per cent.). Reduction of the substituted vinyl acetic acid with hydriodic acid and red phosphorus followed by cyclization in presence of anhydrous aluminium chloride in benzene solution gave 2:4 dimethyl-7-isopropyl tetralone-1 boiling between 122-23° C./1 mm. (Found: C, 83.22; H, 9.15; $C_{16}H_{20}O$ requires C, 83.33; H, 9.26 per cent.; 2:4-dinitro-phenyl hydrazone m.p. 132-33° C.). Grignard addition of methyl magnesium iodide to the substituted tetralone above, followed by dehydrogenation with sulphur gave 2:4 dimethyl eudalene, b.p. 115-16/2 mm.; m.p. 65° C. (Found C, 90.53; H, 9.27; $C_{16}H_{20}$ requires C, 90.57; H, 9.43; Picrate derivative m.p. 120-21° C.; Tri-nitro-benzene derivative, m.p. 137-38° C.).

Our thanks are due to Dr. B. H. Iyer for his kind interest in the work.

Dept. of Organic Chemistry, R. C. GUPTA.
Indian Inst. of Science, M. S. MUTHANA.
Bangalore,
November 15, 1952.

FOOD VALUE OF THE EDIBLE PORTION OF THE INDIAN CHANK *XANCUS PYRUM*

THE Indian sacred Chank (*Xancus pyrum*) is fished in large quantities on the East Coast of the Madras Presidency in the Tanjore, Tinnevelly and Rammad Districts. It is a monopoly of the Government of Madras and the fishing is conducted under the aegis of the Fisheries Department, the fishing season being from November to April. The Chanks find a ready market for making bangles and other articles of curios in West Bengal, Assam and East Pakistan.

The fishermen consume the edible portion of the Chank consisting of the muscular foot, which forms on an average 3 per cent. of the total weight of the shell. The edible portion is pulled out of the shell by means of a sharp knife. This note is presented with a view to evaluate its food values.

The popular method of using the flesh of the Chanks is as follows:—The flesh is boiled in water with a trace of salt for taste until it is nearly cooked. Then it is cut into thin slices and dried in the sun for two or three days. These chips are stored in air-tight containers and made use of when necessary by frying in deep fat, and are considered a delicacy by fishermen.

The table below gives the analytical values of both the Chank flesh in the raw state, and the Chank flesh as dry chips. The methods of

TABLE I
Food Values of Chank Flesh (raw) and Chank Flesh (dried chips)

Particulars	Moisture %	Protein %	Fat %	Mineral matter %	Ca %	P %	Iron mg. %	Cu mg. %	NaCl %	
Chank flesh (raw)	..	67.50	24.84	0.82	1.84	0.13	0.094	2.71	0.43	0.35
Chank flesh (dried chips)	..	13.04	70.03	0.46	5.10	0.24	0.32	10.91	0.95	1.28

analysis are the same as those outlined in a previous paper.^{1,2} NaCl has been determined on the ash extract using Mohr's method.³

It will be seen from the above table that the food values of the flesh of Chank compare favourably with the preserved form and are in general agreement with those of fish. At present, as the quantity produced is not very large, only fishermen consume most of it. They are thus having a rich source of protein food. The protein and the minerals especially invite special attention and it is to be hoped that ere long the Chank flesh chips will become quite popular with other classes of people as a high protein food in diet and that the supply will also improve.

The assistance of Sri. A. D. Isaac Rajendran, Research Assistant, Tuticorin, in making available the samples for our investigations is acknowledged.

Fisheries Tech. Station, R. VENKATARAMAN.
Kozhikode, S. T. CHARI.
November 11, 1952.

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3. Mohr, Fr., Quoted in "Volumetric Analysis," by Kolthoff and Furman, John Wiley & Sons, New York, 1929, **2**, 211.

A CASE OF NATURAL ADAPTABILITY OF ANOPHELES LARVAE TO SEA-WATER

It is found that oviposition responses of some Anophelines in captivity are quite different from the responses found in nature (Mehta,¹ Thomson²). The present account is the case of *Anopheles* larvae that were found breeding in the sea adjoining the Madras beach. On 27th August 1952, two Anopheline larvae of the First instar stage were found in sea-water taken from the shore at the breaker-level, and brought to the University Zoology Laboratory. In order to test whether they would survive, the larvae were kept in a finger-bowl of sea-water for further observation. The water was renewed

every day to keep the salinity and pH without much deviation. The salinity tested was found to be 32.68% and pH 8.3. It was found that the larvae were very active in their habits, moulted as usual, passed through all the larval stages, pupated, and finally the adults emerged from the pupae on the 12th day. The adults were both males, and were determined to be either *Anopheles subpictus* or *A. vagus*, because the males of both species possess the same characteristics.

First instar found on August 27th, second instar emerged on August 29th, third instar on September 1st, fourth instar on September 4th, pupa on September 6th, and adult on September 8th.

There are no drains directly entering the sea for these larvae to have been washed down. The river which opens into the sea had its mouth closed by the sand bar, nor was there any rain at that time to wash down water from any artificial pools nearby.

This observation is interesting because of two unusual features, one of which is the adaptability of the larvae to sea-water. *A. subpictus* and *A. vagus* are found everywhere in India, their larvae being found in a very wide range of habitats, from the purest to the foulest types of water. But, in nature, they are not found to breed in sea-water. The second is their capacity to resist the pounding action of the waves on the margin of the shore. This is really surprising, because one of the methods employed in eradicating mosquito larvae is to resort to agitation of water by producing fast currents or violent waves. Here, on the other hand, the agitation of water is mightier than that produced artificially.

Zoology Res. Laboratory, V. O. SEBASTIAN.
Chennai, Madras,
November 11, 1952.

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BUFFER CAPACITY AND RELATED PROPERTIES OF SOME SOILS OF DELHI AND ITS NEIGHBOURHOOD

ORGANIC acids in the neighbourhood of their half-neutralized states exert strong buffer action. Using half-neutralized acids of different dissociation constants, Schofield⁵ made use of their

correspond more closely to moisture relationship existing under natural field conditions. Applying similar ideas to the present instance, it is clear that the pH at which the buffer curves cut the line of zero-exchange of bases, should correspond to the pH value of the soil. Table II records the pH of the samples as determined

TABLE I

Soil	pH 1.3	pH 2.0	pH 4.6	pH 7.2	pH 9.8	pH 12.5
Gheora 0"-6"	..	-16.62	- 8.84	- 2.50	- .9	+ 4.60
Gheora 6"-12"	..	-16.16	- 7.63	- 4.20	- .68	+ 8.00
Gheora 12"-22"	..	-20.37	- 8.8	- 3.93	- .34	+ 9.35
Gheora 22"-36"	..	-26.14	-11.78	- 8.08	- 1.8	+10.1
B.D. Plot 0"-6"	..	-21.51	- 6.22	- 5.86	- .50	+ 4.70
D.B. Plot 6"-18"	..	-21.74	- 7.30	- 3.60	.00	+ 4.80
B.D. Plot 18"-30"	..	-21.72	- 7.40	- 3.70	.00	+ 4.80
B.D. Plot 30"-42"	..	-32.56	-11.70	-11.0	.51	+ 4.80
Kamruddinagar 0"-6"	..	-15.03	- 8.00	- 2.40	.50	+ 4.4

* Negative sign indicates that the soil gives up base to the buffer solution to be isohydric with the buffer in respect of hydrogen-ion concentration.

buffer properties to study base saturation of soils at different pH values. Raychoudhuri and co-workers⁴ used the same technique in their studies on the Red soils of India in respect to their buffer properties and pointed out their importance in soil-classification. Working with some soils of Delhi and its neighbourhood, it has been found that these buffer curves would yield valuable information regarding mineralogical make-up of soils. Data obtained with these soils are shown in Table I above.

The milliequivalents of base exchanged when plotted against the corresponding pH gave smooth curves with an inflection at or near about pH 4.6. Pure mineral specimens of kaolinite, montmorillonite, and illite have been examined similarly, and from the similarity of behaviour, the soils have been found to be montmorillonitic. Chemical analysis and electrometric titration of the clay-fractions confirmed the results.

The buffer curves can thus be utilised on the same lines as the electrometric titration curves to obtain useful data on the electrochemical nature of soil acidoids.

It is usual to obtain the soil pH values with a fixed soil water ration, either electrochemically or colorimetrically. Puri and Sarup³ have pointed out the inherent defect in such a procedure and suggested the iso-hydric pH value as an index of soil reaction. Mattson¹ called this pH the point of exchange neutrality. Megeorge² in a recent publication, has pointed out the similarity between the iso-hydric pH values and the pH values of soil paste which

from the buffer curves and by the glass electrodes at soil water ration 1 : 2.5.

TABLE II

Soil No.	Glass Electrode (pH)	Buffer curve (pH)
Gheora I	..	7.48
Gheora II	..	7.55
Gheora III	..	7.74
Gheora IV	..	7.90
B.D. I	..	7.60
B.D. II	..	7.68
B.D. III	..	7.68
B.D. IV	..	7.88
Kumruddinagar	..	7.45

It will be observed that the pH indicated by the glass electrode is generally higher than that obtained from the buffer curve.

The buffer pH is, however, more informative than the pH determined by the conventional methods; the former value is related more closely with the saturation state of the soil acidoids.

The author is thankful to Dr. S. P. Raychoudhuri for his criticism and suggestions during the course of the work.

Indian Agri. Res. Inst.,

A. K. DAS.

New Delhi,

July 28, 1952.

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REVIEWS

Major Faults on Power Systems. By A. G. Lyle. (Chapman & Hall Ltd.), London. Pp. 355. Price 45 sh.

The volume is the latest of a series of monographs on Electrical Engineering published under the editorship of Mr. H. P. Young.

The book aims at a critical examination of the behaviour of power systems under fault conditions. The author has indicated the method of approach to the problems in connection with faults and their consequences, rather than giving a formal, comprehensive and, perhaps, tedious treatment of every possible fault which can arise. More emphasis has been laid on discussing what actually happens and the magnitudes of current and voltage attending the incidence of various kinds of faults, leaving detailed information on switchgear, protective gear and transient phenomena to be obtained from the many excellent and specialised books already available. Only such descriptions and discussion on the protective equipments have been included which are essential to the investigation of their performance.

In the introductory chapter the origin and effects of faults and some of the phenomena associated with insulation failure are discussed; the magnitudes of currents and voltages due to lightning and switching surges are investigated. The range and scope of surge voltages have been discussed in an elementary way with the help of Heaviside's operational calculus. Empirical formulae are developed from an analysis of sudden short circuits on alternators and these are checked with actual test results. The consequences of fault-explosion and fire—are discussed in the next chapter and the means to restrict the damage due to fire are indicated.

As a background to the understanding of the solution of more complicated problems on network analysers, it is necessary to understand the solution of simple cases by calculation. Such a background is provided in the two chapters dealing with elementary fault calculations by the method of symmetrical components and calculation of system faults for different types of faults. In his effort to simplify the presentation of fault conditions, however, the author's remark that "transformers generally have the same reactance for all sequences" is somewhat vague and may lead to misunderstanding, since the values of zero sequence impedances depend

so much on the method of connection of the transformer windings and other apparatus.

Three chapters are devoted to protective devices which have been subclassified by the author as: (a) self-contained protective devices consisting of surge diverters, surge absorbers, Petersen coil; and (b) ancillary protective gear such as relays and relay protective schemes whose function is to operate circuit breakers. Two chapters are devoted to oil circuit breakers and a third chapter deals with high voltage outdoor circuit breakers.

Chapter XI deals with the design of switchgear structures as adapted in British systems. In the next chapter consistency of systems design is discussed stressing the necessity of co-ordination of fault capacity with circuit breaker capacity, size of connecting conductors and current transformers and potential transformers. Sudden heating and its effect as also the protection of potential transformers are discussed.

A whole chapter has been devoted to the problem of Neutral Inversion—some new material in books of this nature. As pointed out by the author, the incidence of neutral inversion is rare but possible. Hence an idea as to the causes leading to neutral inversion, its effect and magnitude will be useful in that necessary preventive measures can be taken where needed.

In each chapter a number of examples and calculations are given in illustration of the principles discussed. There are a few printing mistakes and omissions which, it is hoped, will be corrected in the next edition. References, mostly from English sources, are given at the end of each chapter.

Mr. Lyle's book gives a critical review of the British practice and is a very useful addition to the existing literature. Though primarily written to assist the practising engineer, the book will also be very useful to the advanced students in electrical engineering.

C. S. GHOSH.

Elements of Radio Engineering. By H. I. F. Peel. (Published by the Cleaver-Hume Press Ltd., London), 1952. First Edition. Pp. viii + 232. Price 10 sh. 6 d. nett.

When a large number of books on radio are available, there must be justification for a book of this kind. The author has really produced

a book which can justify its existence. It is written in a very elementary manner and is most readable. It covers the ground necessary for our diploma students in other branches of engineering who have to be taught something about radio communication.

The book is divided into 12 chapters covering valves, A.C. theory, valve as an amplifier, use of capacity and inductance in A.C. and D.C. circuits, power supply, tuning circuits, oscillator circuits, detector circuits, the receiver, radio measurements and the cathode ray oscilloscope. A very useful part of the book is the examination questions and answers. There is a brief index. Most of the treatment is with the help of graphs. There are a very large number of very useful and extremely well-drawn diagrams. The printing and get-up of the book is very good.

The book can be very strongly recommended to all engineering diploma students who need to acquire an elementary knowledge of radio. It is the type of book that should find a place in the science section of school and Intermediate College libraries for the use of students who display an interest in radio communication.

S. V. CHANDRASHEKHAR ATYA.

The International Review of Cytology, Vol. I.

Edited by G. H. Bourne and J. F. Danielli. Academic Press Inc. Publishers, New York), 1952. Pp. 368. Price \$ 7.80.

The International Review of Cytology would be gladly welcomed not only by the specialists concerned but by all students of the biological sciences. The Editors have wisely decided to keep the scope of the reviews very wide in order that all aspects of cell biology may be covered. Though the articles are "individual and unrelated reviews of specific subjects", there is a balance in the topics presented.

Important lines of advance in cytological technique have been well summarized in "The Application of Freezing and Drying Techniques in Cytology" by L. G. E. Bell and "The Electron-Microscopic Investigation of Tissue Sections" by L. H. Bretschneider.

The problem of differentiation and development receives attention from two different angles : G. Fankhauser—Nucleo-Cytoplasmic Relations in Amphibian Development, and C. L. Huskins—Nuclear Reproduction. Huskins has summarized data which "though none alone may be conclusive, together suggest a need for revision and extension of some of our more orthodox concepts on various aspects of repro-

duction of the nucleus and its components and the role of the nucleus in differentiation and development" (p. 21). It is questionable whether his defence of the use of the terms *polyploidy*, *polysomy*, and *polyteny* synonymously would appeal to other workers. The statement pertaining to the DNA charge in nuclei (p. 22) appears self-contradictory because the first part conveys a sense exactly opposite to that of the latter half. It is of course now recognized that the DNA content of nuclei are correlated with the number of chromatids present.

The mechanism of mitosis, though debated over many years, has scarcely received any satisfactory solution. In a persuasive article, "Structural Agents in Mitosis", based on observations of the changes in the physical properties of the dividing cell, Swann argues that chemical agents are most likely to be responsible for the structural changes in the cell during mitosis. The two articles, "Enzymatic Processes in Cell Membrane Penetration" by Th. Rosenberg and W. Wilbrandt and "Protoplast Surface Enzymes and Absorption of Sugar" by R. Brown deal with similar topics. The first one is more comprehensive and critical. The physico-chemical basis for osmotic work done by the cell is ascribed to the folding and unfolding of protein molecules by R. J. Goldacre, who argues out convincingly all the implications of such a concept, marshalling impressive evidence in support.

With the use of dyes in cytological work expanding in scope every year, it is gratifying to find that an able and critical summary (M. Singer : "Factors which Control the Staining of Tissue Sections with Acid and Basic Dyes") of the various factors affecting the process of staining has been included in this volume. Though the subject of bacterial cytology is still a controversial one, considerable weight is lent to the views of some of the workers in view of the fact that most of their observations using the standard cytological techniques have been confirmed by examining living cells by phase-contrast microscopy. Notwithstanding this, one wonders whether the time is ripe for a re-orientation of our ideas on Bacterial Systematics and Evolution based on the present knowledge of cytology as suggested by Bisset ("Bacterial Cytology"). "The Behaviour of Spermatozoa in the Neighbourhood of Eggs" by Lord Rothschild provokes the question whether this review has not been a little premature.

Advances in other fields of cytology summarized are: Enzymic Capacities and Their

Relation of Cell Nutrition in Animals" by G. W. Kidder, "Reproduction of Bacteriophage" by A. D. Hershey, "The Cytology of Mammalian Epidermis and Sebaceous Glands" by W. Montagna, and "The Histochemistry of Esterases" by G. Gomori.

Notwithstanding the many critical remarks which might come to the mind of the reader on a perusal of the articles, one cannot fail to be impressed by the wealth of information and the stimulating discussions contained between the covers of this book. The question of striking a proper balance between facts and hypotheses has always been a tricky one and if, in this volume, the balance appears weighted a little more in favour of the latter, one has to remember that after all hypotheses, once their essential nature is understood, play a very useful role in any branch of science which is advancing rapidly.

In regard to ideas and theories in cell biology, nothing can be more salutary than a consideration of the following remark by Hughes ("Some Historical Features in Cell Biology"): "In conclusion one may say that since in some ways cell biologists are on old ground working with new implements it would be as well if they recognized more fully the antiquity of their sites and looked out for the old forgotten tracks, along which something of value might still be found. A few more ideas, however ancient, would still be useful in cell biology" (p. 6).

If the first volume is any indication, one can look forward to a number of valuable publications in this series giving authoritative and critical summaries of advances on all the fronts of cytology and cell physiology.

M. K. SUBRAMANIAM.

Nuclear Data. (Supplement 3 to N. B. S. Circular 499). (U. S. Department of Commerce, Washington), 1952. Pp. 66. Price \$ 4.25.

This is the third and the last supplement to the main compilation on Nuclear Data, N. B. S. Circular 499, and contains data reported during the period January 1951 to July 1951. Nuclear physicists, radio-chemists and other workers in nuclear science are now quite familiar with this valuable work of reference, which presents a comprehensive collection of experimental values of half-lives, radiation energies, relative isotopic abundances, nuclear moments and cross-sections. Decay schemes and level diagrams are given wherever possible. It is estimated that at present over 1,000 new measurements of

nuclear properties are being reported each year in some thirty different journals and the need for a suitable listing of available data is keenly felt by all workers in nuclear physics. The need is satisfactorily met by this work on Nuclear Data. The value of Supplement 3 is further enhanced by inclusion in it of a list of fission and spallation papers and a list of packing fraction differences. It has been announced that the N. B. S. nuclear data group will continue to do this important work, in future, in conjunction with the semi-monthly abstract journal, *Nuclear Science Abstracts*.

B. V. THOSAR.

The Skeleto-Muscular Mechanism of *Stenobracon deesae* Cam.—An Ectoparasite of Sugarcane and Juar Borers of India, Part I: Head and Thorax. By S. Mashhood Alam. Edited by Prof. M. B. Mirza. (Aligarh Muslim University Publications, Zoological Series, No. 3). Pp. 74. Plates ix. Price Rs. 5-8-0.

The publication under review would appear to be a part of a thesis on which Dr. Mashhood Alam had been working and deals with the skeleto-muscular mechanism of the head and thorax of *Stenobracon deesae* Cam., a common hymenopterous parasite of economic importance. The author has dealt with the subject in an elaborate and thorough manner. The large mass of descriptive matter is interspersed with brief discussions of the views of earlier workers in the field. Descriptions of the skeletal structure and the musculature of the body—an aspect difficult of investigation and often neglected—have been rendered possible by the successful technique employed; and the work is altogether a notable contribution to our knowledge of the intricate skeleto-muscular mechanism of the insect body. The text is adequately supported by a good number of well-drawn figures printed on art paper. The publication is altogether attractive both in form and content. Dr. Mashhood Alam is indeed to be congratulated on the successful handling of a difficult and exacting research problem under the inspiring guidance of Dr. M. A. H. Qadri and Prof. M. B. Mirza.

D. S. RAO.

Indian (Mysore) Linaloe Oil. By Sri. S. G. Sastry (Board of Scientific and Industrial Research, Government of Mysore).

This monograph on Mysore Linaloe Oil is a very welcome addition to the literature on essential oils. The interesting and vivid story

of the history of the origin and development of Linaloe plantation in Mysore is another epic in the development of plantation industry in India. Every part of the linaloe tree contains oil, Mysore specialising in the production of oil from the berries and husks. The cultivation potentialities of this plant are very great and all who are interested in the subject must study this monograph.

K. N. M.

Biologie D'Anopheles Gambiae. By M. H. Holstein. (Recherches en Afrique-Orientale Française. Organisation Mondiale de la Santé. Palais des Nations, Genève), 1952. Prix : Fr. s. 8, 10/-, \$ 2.00.

By presenting the monograph on the biology of *Anopheles gambiae* Dr. Holstein has done an invaluable service not only to the science of malariology, but also to some of the general biological problems for which evidence at present is scanty. Chapters I and II are devoted to the description of the meteorological conditions of French West Africa, and to the techniques used for collection, transport, dissection etc., of *A. gambiae*. Chapters III to VII deal with the life-cycle, individual variations of various stages, nocturnal activities of adults, role in malaria transmission, and racial peculiarities of this notorious African malaria-carrier. All these facts, collected during two years of painstaking investigations, and vividly described within the confines of a beautiful handbook is one which every student of malariology would like to possess. Another study of great interest is the comparison of the various responses under natural and laboratory conditions, which in mosquitoes are often at variance with one another. The results are also critically analysed with reference to a review of all the existing literature pertaining to the problem. Such a work should help to stimulate the publication on similar lines monographs of other malaria-carriers of the different parts of the globe, whose literatures are scattered far and wide.

The great merit of the book lies in the exposition of two biological phenomena. One is the resistance of *A. gambiae* to withstand the rigours of prolonged hot summer months. True hibernation in mosquitoes is found in cold seasons, whereas in hot seasons they are supposed to undergo rapid mortality. Here, on the other hand, *A. gambiae* adults pass through the dry season in a way mid-way between gono-tropic dissociation and concordance, which the author

calls 'pseudo-hibernation'. The second is the discovery of racial differentiation of *A. gambiae*—the zoophytic and anthropophytic forms by careful studies on the maxillary index, precipitin tests and larval breeding places. The paucidentate populations are anthropophytic, breeding in water with less of organic content of vegetable origin, the multidentate populations being zoophytic, breeding in water of large organic-matter content. The terms 'organic' and 'inorganic' forms used by the author may be convenient expressions to denote the differences, but what is noteworthy is that the coincidence of structural peculiarities and physiological behaviour is an indication of the gradual evolution of physiological species.

The annexes giving details of the distribution of *A. gambiae* throughout the Ethiopian region, the sporozoite-rate, and key to the identification of adults and larvae of *Anopheles* of French West Africa are valuable additions to the book.

V. O. SEBASTIAN.

Books Received

- Phylogeny and Morphogenesis.** By C. W. Wardlaw. (Macmillan & Co. Ltd.), 1952. Pp. 536. Price 42 sh.
- Tables of the Bessel Functions.** (United States Government Printing Office, Washington), 1952. Pp. xi + 60. Price 40 cents.
- Commercial A.C. Measurements.** By G. W. Stubbings. (Chapman & Hall), 1952. 3rd Edition. Pp. xvi + 377. Price 50 sh.
- Alternating Current Wave Forms.** By Philip Kemp. (Chapman & Hall), 1952. 2nd Edition. Pp. ix + 406. Price 50 sh.
- The Basis of Mine Surveying.** By H. Hardlock. (Chapman & Hall), 1952. Pp. xii + 301. Price 30 sh.
- Science Magic.** By Kenneth M. Swizy. (McGraw-Hill & Co.), 1952. Pp. x + 182. Price \$ 3.75.
- Thermal Diffusion in Gases.** By K. E. Grew and T. Libbs. (Cambridge University Press), 1952. Pp. xi + 143. Price 22 sh. 6 d.
- High Speed Photography.** By G. A. Jones. (Chapman & Hall Ltd.), 1952. Pp. xiii + 311. Price 42 sh. net.
- Designing by Photoelasticity.** By R. B. Heywood. (Chapman & Hall Ltd.), 1952. Pp. xv + 414. Price 65 sh. net.
- Superconductivity.** By D. Shoenberg. (Cambridge University Press), 1952. Pp. x + 256. Price 30 sh.
- Ink and Paper in the Printing Process.** By Andries Voet. (Interscience Publishers Inc., New York), Pp. xii + 213. Price \$ 5.90.

SCIENCE NOTES AND NEWS

Smoke Points of Fatty Oil—White Oil Mixtures

Shri J. G. Kane and G. M. Ranadive, Department of Chemical Technology, University of Bombay, Bombay 19, write as follows:

Smoke point of a fatty oil is a guide to the use of the oil as a frying or a heating medium. Small amounts of fatty acids depress the smoke point of fatty oils considerably (Morgan, D. A., *Oil and Soap*, 1942, 19, 194). The authors observed that addition of white oil to fatty oil markedly lowered the smoke point of the latter in almost the same manner. Therefore if refined or crude fatty oils show very low smoke points inconsistent with their f.f.a. contents, white oil may be suspected to be present in them.

Introduction of the Exotic Cichlid Fish, *Tilapia mossambica* Peters. in Madras

Sri. D. D. Peter Devadas and P. I. Chacko, Freshwater Biological Station, Madras, write as follows :

A consignment of 500 fry (12 to 35 mm. in size) of *Tilapia mossambica* was imported to Madras from Ceylon on 8th September 1952. The fish were transported without any casualty in a tin container sealed with oxygen. This is the first instance of introduction of this exotic fish to India. Within a short time of three months the fish has responded favourably to the new environmental conditions of Madras. In the Chetpet Fish Farm it has not only attained to a size of 135 mm. and weight of 50 gm. by the end of November 1952 but has also bred prolifically. It grows well in association with local species like *Catla catla*, *Cirrhina mrigala*, *Labeo rohita*, *L. fimbriatus*, *Cyprinus carpio* and *Oosphronemus goramy*. Non-cannibalistic habit, rapid growth and propagation, parental care, harmless association with indigenous species, adaptability to different types of fresh and brackish waters, capacity to withstand handling and transport and algicidal propensities make *Tilapia mossambica* an ideal fish suited for culture in South Indian waters, many of which dry during the summer.

A Simple Method of Germinating Sweet Potato Seeds

Messrs. L. Venkataratnam and K. Satyanarayananamurthy of the College of Agriculture, Bapatia, Madras, write as follows :

Seeds resulting from hybridisation of different clones of sweet potato (*Ipomoea batatas* Lam.) are hard-coated and do not germinate even after months of storage. Among the various attempts made to germinate the seeds, treatment with sulphuric acid was found the best for breaking dormancy and the imperviousness of the seed-coat. Over 60 per cent. germination was obtained as against 4 to 5 per cent. secured from untreated seeds.

Moist seeds are dropped into concentrated sulphuric acid just adequate to soak the seeds and the seeds are allowed to stand in the acid for about 10 minutes and then poured in a basin full of water. These can be washed and sown immediately. The treatment is simple and has no injurious effects. Dry seeds do not respond to the same extent as moist seeds as sufficient heat has to develop for proper wearing down of the seed-coat.

We are grateful to Professor T. C. N. Singh of the Annamalai University for many useful suggestions.

The Bose Institute—35th Anniversary Meeting

The Bose Institute celebrated the 35th Anniversary of its foundation on November 30th, 1952. The Director, before presenting his report on the working of the Institute for the past year, took the opportunity to refer to the 50th Anniversary of the publication in 1902 of Acharya Jagadish Chandra's book *Response in the Living and the Non-Living* which had at the time of its publication evolved a great deal of interest in learned circles. He reviewed in the light of the present-day knowledge, Acharya Bose's contribution to response phenomena in general. He also announced the receipt of a legacy of £ 5,000 from the Executors of the late Miss Edith Keating of London, income from which will be utilised for the creation of a Fellowship in the Bose Institute, which will be known as the Edith and Richard Keating Research Fellowship.

Award of Research Degrees

The following students of the Institute of Science, Bombay, have been declared eligible by the University of Bombay for the Degree of Doctor of Philosophy in Physics on the basis of the theses in the subjects shown against their names :

Shri K. S. Korgaokar, "Influence of Oxygen on the First and Second Positive Systems of Nitrogen"; Shri B. S. Patil, "Study of the Rotational Energy Distribution in Some Hydrocarbon Bands"; Shri G. K. Mehta, "Probe and Spectroscopic Studies in the High Frequency Discharges"; and Shri D. D. Desai, "Influence of Argon on the First and Second Positive Systems of Nitrogen".

Indian Botanical Society

The following Officers of the Indian Botanical Society have been constituted for the year 1953 as the result of election at the 32nd Annual General Meeting of the Society held at Lucknow :—

President: Dr. K. A. Chowdhury, Dehra Dun; *Vice-Presidents*: Dr. K. Biswas, Calcutta; and Dr. S. N. Das Gupta, Lucknow; *Hon. Secretary*: Dr. R. Misra, Sagar; *Treasurer and Business Manager*: Dr. T. S. Sadasivan, Madras; *Editor-in-Chief*: Dr. A. C. Joshi, Jullunder.

Surface Conductive Glass

Tin salts can be baked into the surface of glass, changing it from an insulating material into a conductor for electricity. From this fact spring several novel applications including defrosting windows and wind screens and 'cold' lighting devices.

Hydrodynamic Lubrication

The behaviour of a journal bearing running eccentrically in a bush has been studied to check the validity of Sir Geoffrey Taylor's criterion for critical speed, worked out for one cylinder rotating concentrically inside another. Results of experiments so far show that the

designer who arranged that Taylor's value was not exceeded would be on the safe side. This research is important because of the advent of the gas turbine and the introduction of rapidly rotating machinery for refrigerators and so on. They demand bearings running faster than has been usual up to now.

Protosynchotron at Canberra

An atomic accelerator producing protons with energy of the order of 15,000 mev. is being built by Professor M. L. Oliphant at the Australian National University, Canberra. The protosynchotron under construction is an improvement over the better known cyclotrons and synchotrons in the U.K. and the U.S.A. One of the limiting factors in the cyclotron principle thus far has been the focussing of particles within the magnetic field so that they hold on to the destined path. A discovery made at Brookhaven improved the focussing to a degree previously unknown. The Canberra construction is at the stage where the new improvement could be incorporated. With the extended range thus made possible for the study of properties of matter, Professor Oliphant and his assistants hope to obtain significantly new knowledge on the effects of particles on atomic nuclei.

Indian Phytopathological Society

At the Annual General Meeting of the Indian Phytopathological Society held during the last session of the Indian Science Congress at Lucknow, the following members were elected to the Council for 1953:

President—Dr. R. S. Vasudeva; *Vice-President*—Dr. S. N. Das Gupta; and *Secretary-Treasurer*—Dr. R. Prasada.

NOTICE

All material intended for publication in *Current Science*, corrected proofs, books for review and exchange journals, may please be sent to the Editor:

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